Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

FEBRUARY 1954

VOLUME 37 • NUMBER 2

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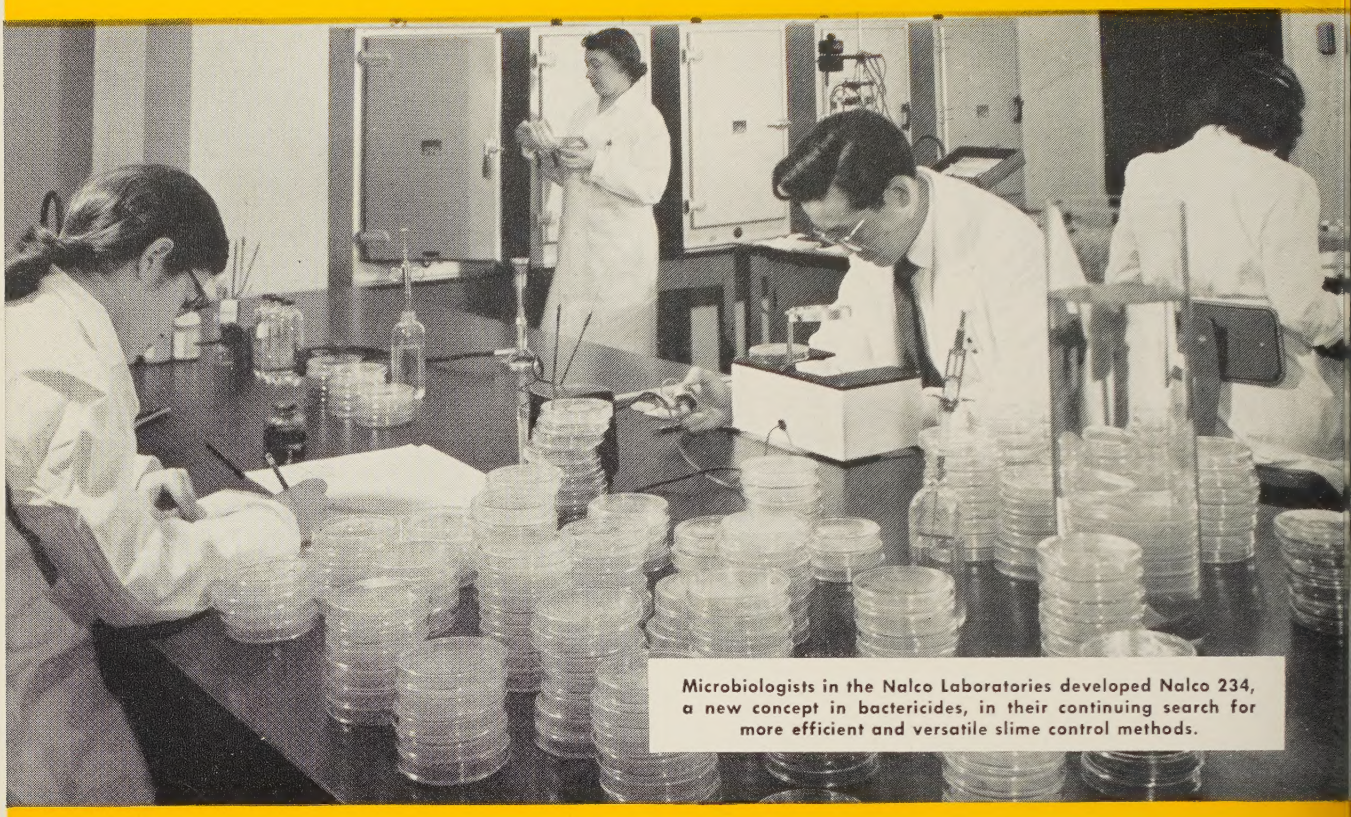

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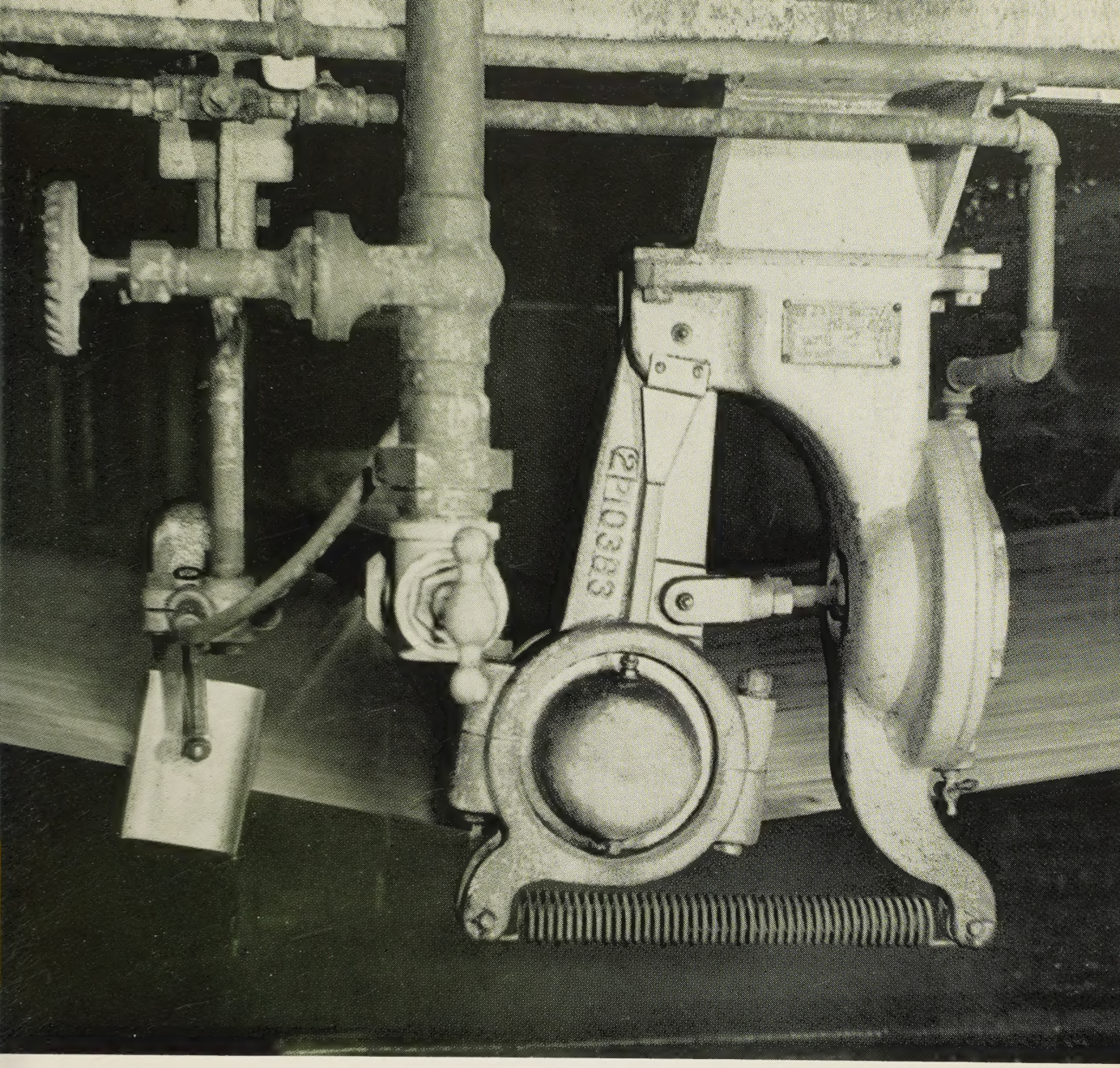

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What is all this talk about service?

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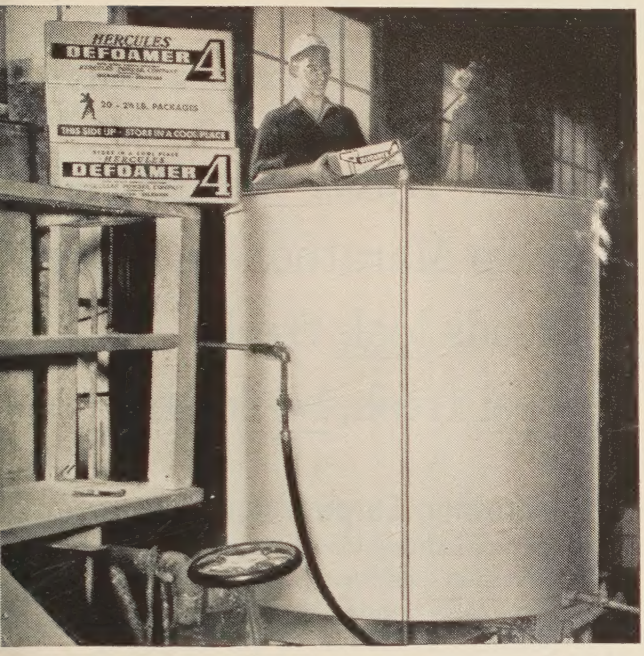

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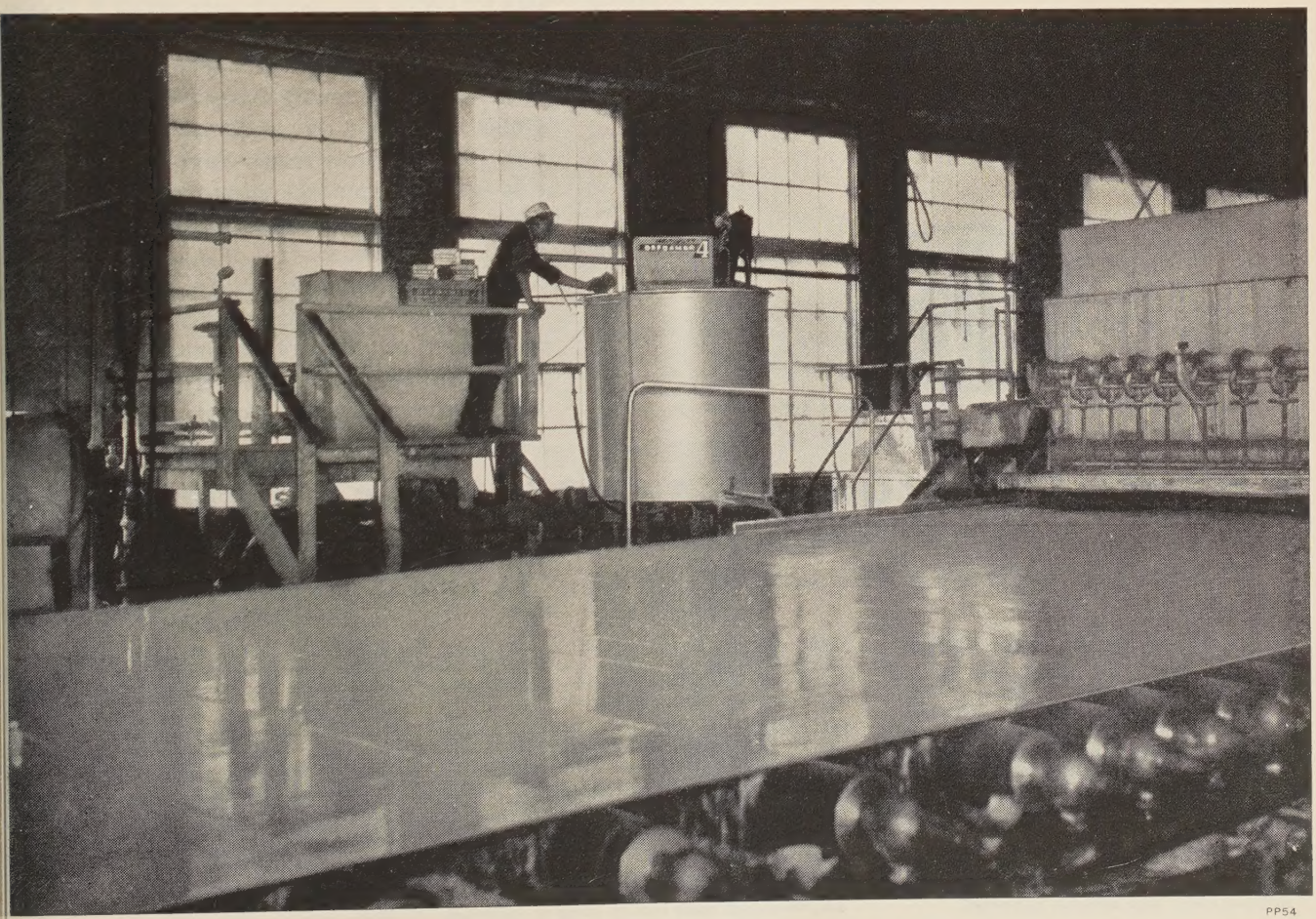

PP54

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How Huber filler clays help Marathon-packaged foods look fresh, feel fresh, be fresh

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3. Particle Size	7. Gloss	11. Abrasion
4. pH	8. Opacity	12. Moisture
		13. Suspension

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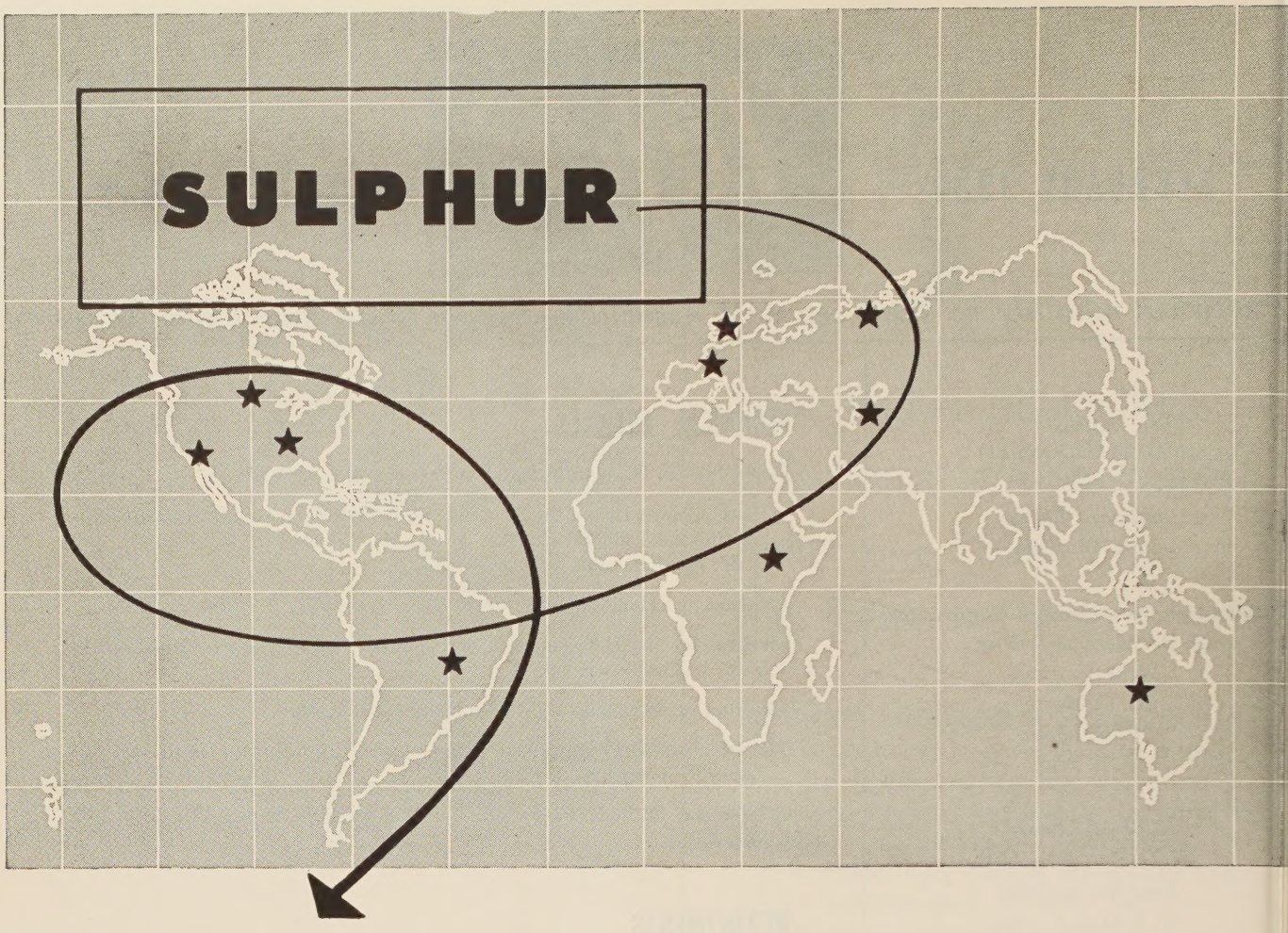

the UNITED STATES *is only one producing country!*

Although the United States is the largest producer of elemental sulphur, its production is only about one-half of sulphur in all forms produced in the free world.*

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- MOSS BLUFF, TEXAS
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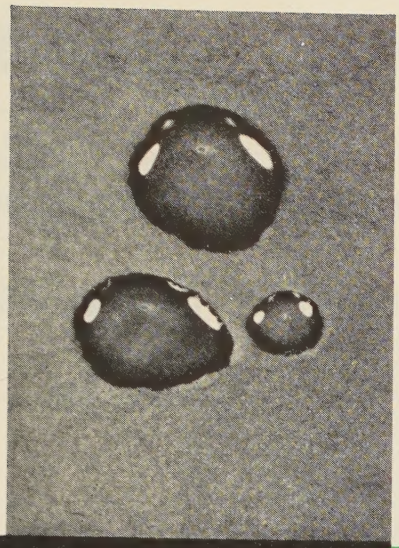

This unretouched photograph shows a 1% solution of Kelsize twenty minutes after being puddled on blotter. Note how solution remains on surface of blotter. This test illustrates that the filming properties of Kelsize or Kelgin hold water on the surface fibers longer thus providing better lubricating action during calendering. This permits more smoothing action by calender rolls before penetration of aqueous solutions occur.

SMOOTHER SMOOTHNESS WITH KELGIN or KELSIZE

THIS BLOTTER TEST SHOWS WHY KELGIN AND KELSIZE SOLUTIONS MAKE PAPER AND PAPERBOARD SMOOTHER DURING CALENDERING.

Here is unretouched photograph of water, without Kelsize, on piece of same blotter, taken seconds after water was placed on blotter. Note how water has immediately passed into blotter compared to controlled penetration of Kelsize solution. Proof that Kelsize and Kelgin are superior surface control agents.

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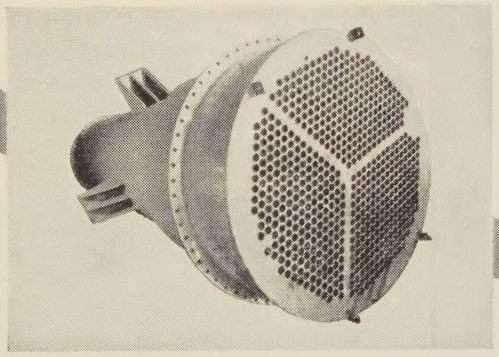
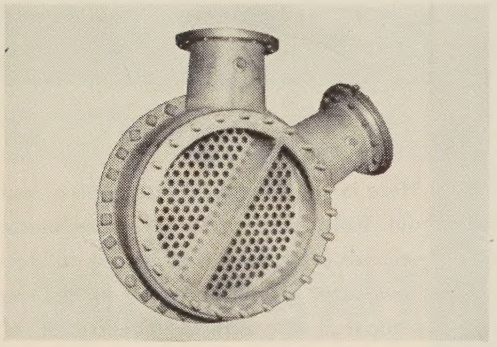
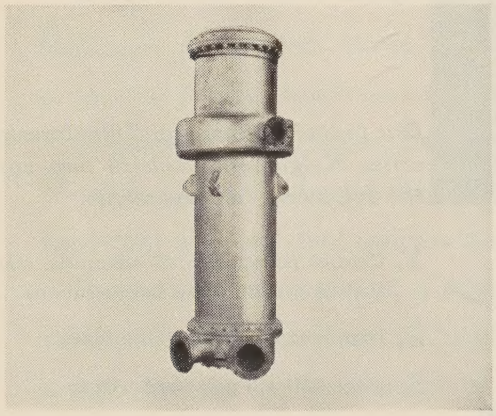


Black Liquor Evaporator



2-pass Heater Manifold



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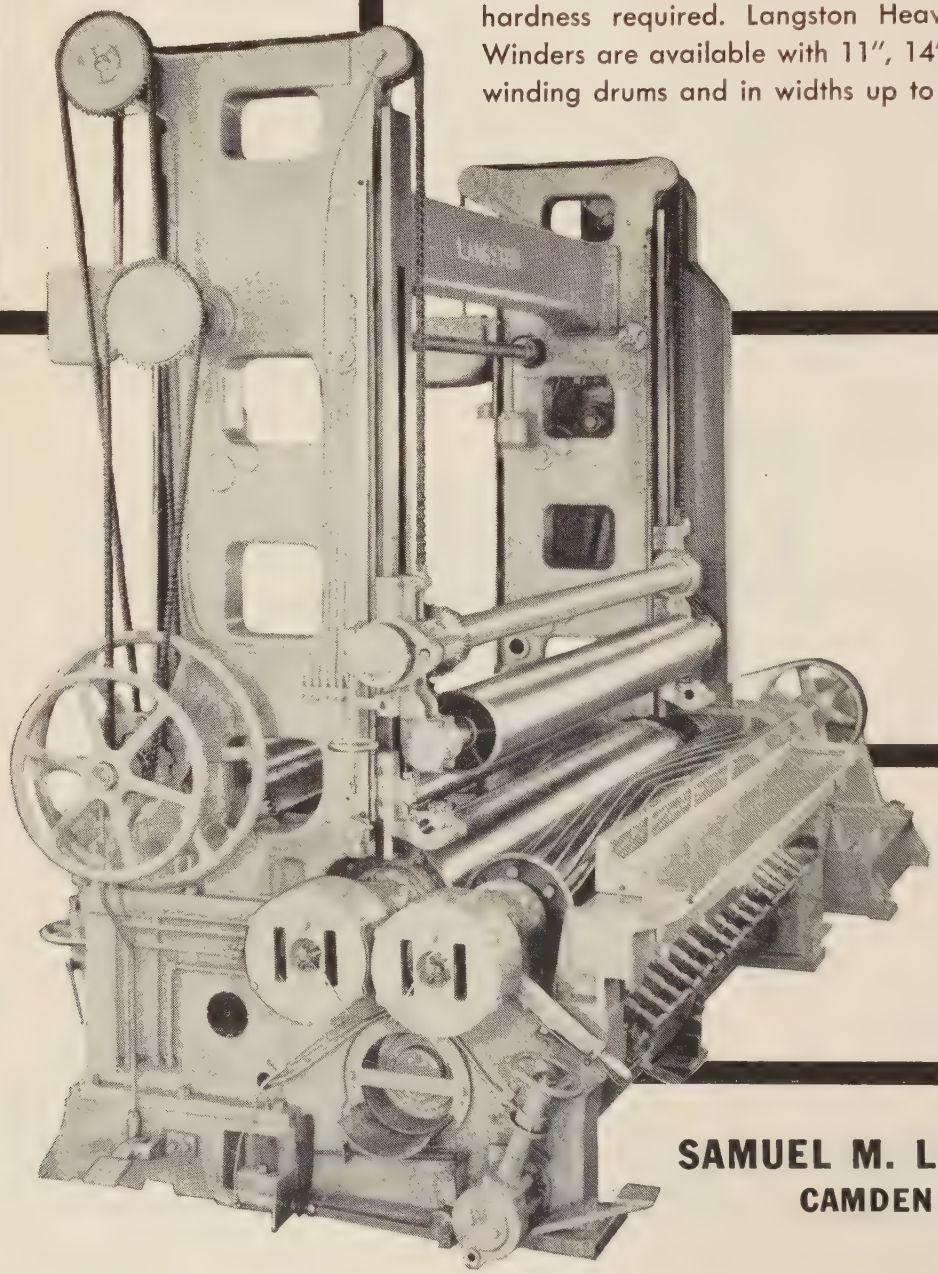

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Ermine Weasel

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but fools will learn in no other."
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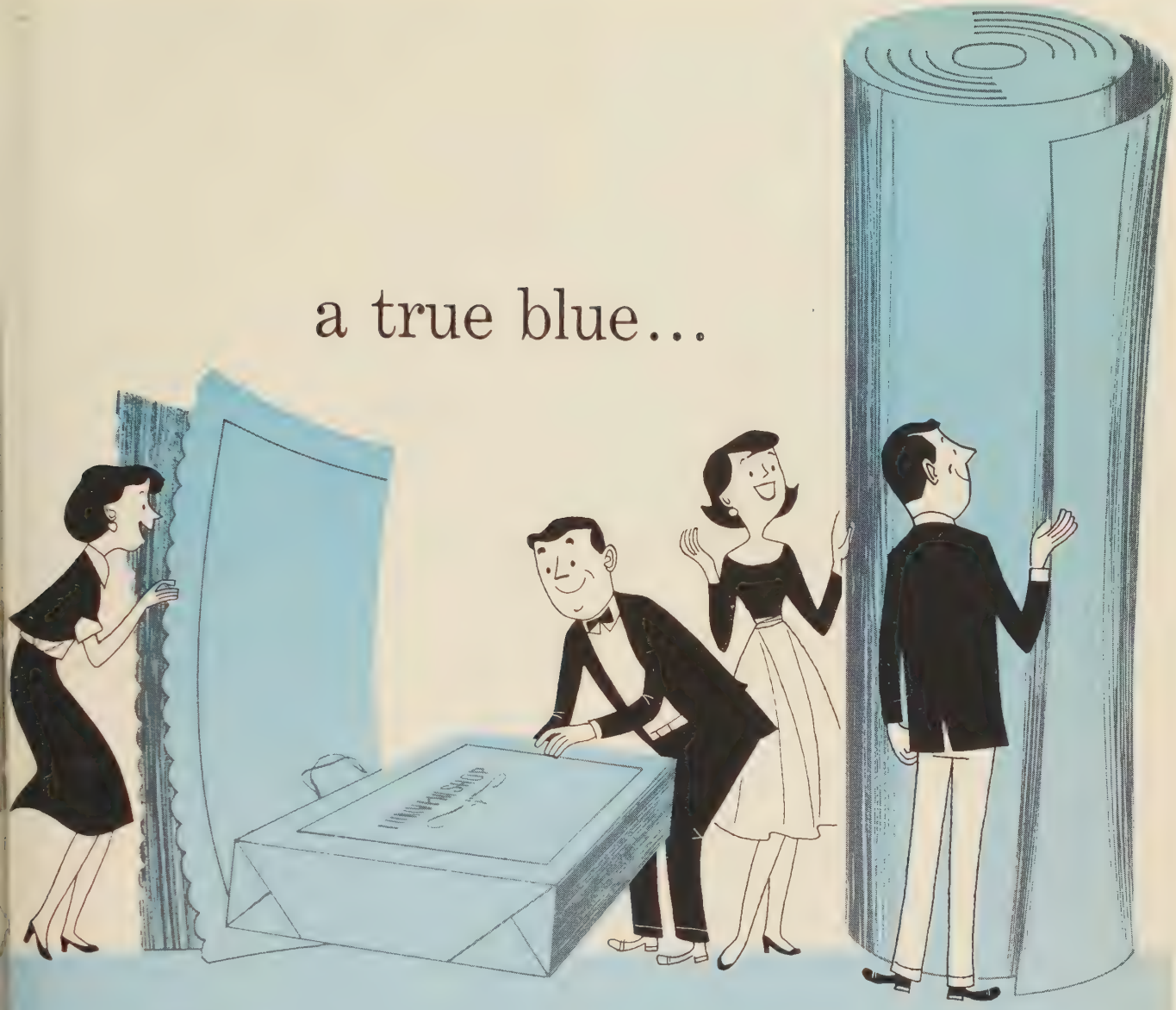
a true blue...



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A blue that's true to its name, to its uniform high standards and to *your* needs is PHENO BLUE 2B EX. CONC.

For use on a variety of papers from lightweight Fourdrinier tissue to heavyweight cylinder board . . .

For producing a range of colors, from pastel tints to deep solid shades . . .

PHENO BLUE 2B EX. CONC. combines low cost, ease of handling, good fastness.

This dependable combination makes PHENO BLUE 2B EX. CONC. highly suitable for many grades of tissue, wrapping, bag, board and specialty papers.

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NORTH AMERICAN CYANAMID LIMITED, MONTREAL—TORONTO

THE DISTRIBUTION OF PULP, PAPER, BOARD, AND PRODUCTS IN THE NATION'S INDUSTRIAL AND BUSINESS ECONOMY*

W. LeROY NEUBRECH and WALLACE H. PEDERSON

Do you know that when motor vehicles are sold to final consumers, the direct and indirect requirement for primary paper and paperboard is nearly 15 times greater than the actual direct purchases of paper and paperboard by the manufacturers of motor vehicles themselves?

Even though the motor vehicle industry purchased directly only $4 million of primary paper and paperboard in 1947, when motor vehicles were sold to final demand, the aggregate of manufacturing processes affecting other industries accounted directly or indirectly for about $62 million of primary paper or paperboard.

The bakery products industry does not directly purchase wood pulp. However, do you know that in 1947 sales to final demand of the bakery products industry accounted directly and indirectly for $29 million of pulp production?

Many other pertinent observations on the distribution of pulp, paper, board, and products in the Nation's industrial and business economy can be made, based upon a relatively new development in statistical data collection and analysis, generally known as "input-output" data or as "interindustry relations." These data have many important applications in the fields of production, distribution, and marketing research.

The input-output statistics are of particular value in appraising the marketing possibilities for those industries which primarily service or supply other industries. The pulp, paper, board, and converted products industries fall largely in this category. Those industries which in the main sell finished goods directly to end-product consumers—that is, to consumers, investors, the Government, foreign buyers—will find it of minor help for marketing research.

A prerequisite is the collection, in an organized form, of a very large amount of quantitative information on purchases and sales among the industrial or processing sectors of the economy. Such a compilation covering the year 1947 was made by the Division of Interindustry Economics of the Bureau of Labor Statistics, U. S. Department of Labor. It is the result of work done in the past several years by the B. L. S. at the request of the National Security Resources Board and the Department of the Air Force.† The work was undertaken as an important step in a broad interagency program directed primarily toward improved industrial mobilization planning.

For the purpose of this extensive and exhaustive study, the total United States economy was divided into some 200 sectors, each representing an important industry, activity, or purchasing group. For each sector, a detailed analysis of specific purchases from, and sales to, the other sectors was made. These analyses were based both on published and supplementary directly collected data, and were reconciled to the available national production records, more particularly the latest Census of Manufactures for 1947. The complete study is probably the most detailed and accurate cross-sectional picture of a working modern industrial economy ever assembled.

The essential notion in the use of input-output analysis is that, while the *pattern of shipments* from one sector to others may change quite significantly from year to year as the requirements placed on the economic system by end-product consumers vary, the *pattern of inputs* into any given sector tends to be more stable and more predictable. A going establishment in a given industry normally represents a collection of machinery and equipment adapted to processing certain materials, and a collection of persons (both in labor and management) skilled in handling, using, and transforming these same materials. Hence, abrupt and capricious changes in input patterns are unusual, even where the firm's customers change, and where they result from technological innovations or for other causes, one is likely to know of them and hence be able to take account of their probable effects. Input-output analysis thus attempts to take advantage of the typical stability of input patterns in order to obtain reasonable answers to many complex and difficult problems of economic analysis. One of the many areas to which this approach promises to contribute significantly is that of marketing research.

APPLICATIONS IN MARKETING ANALYSIS

Input-output tabulations have a number of implications for marketing analysis. Since the statistical work was carried through carefully and in great detail and the results have been reconciled to a great extent with the entire body of the national economic statistics, the results as they stand have considerable informative value.

W. LeRoy Neubrech and Wallace H. Pederson, Forest Products Div., Department of Commerce, Washington, D. C.

* Based upon statistics and analytical material prepared by the Division of Interindustry Statistics, Bureau of Labor Statistics, Department of Labor; including "Marketing Uses of Input-Output Data," printed in *The Journal of Marketing*, July 1, 1952.

† The initial phase of the 1947 interindustry relations study was financed by the NSRB. Most of the later support was provided by the Department of the Air Force. Due to budgetary considerations, the latter agency has withdrawn its support of interindustry research and, consequently, the program is now being liquidated.

Gouverneur Talc Co., Gouverneur, N. Y.

NYTAL

New York State Talc for the Paper Industry —Uniform Quality—

R. T. VANDERBILT CO. INC.

230 Park Avenue, New York 17, N. Y.

To assist executives and research personnel in the pulp, paper, and board industry in analyzing the comprehensive input-output data compiled by the Bureau of Labor Statistics, a realignment of the figures applying to pulp, paper, board, and products into composite and usable tabulation form has been prepared by the Pulp, Paper, and Paperboard Subdivision of the Forest Products Div., U. S. Department of Commerce. These appear in the statistical table at the end of this article.

It will be noted the table is divided into five main columns, designated as columns A, B, C, D, and E; with each column except D subdivided into pulp; primary paper and board; and converted paper and board products.

Starting with column A, it will be noted that this shows the direct distribution of total supply (domestic production plus imports and inventory depletion), in terms of millions of dollars, of pulp, primary paper and board, and paper and board products, to a long list of purchasing industries as well as the direct distribution to final demand, such as export and the Government.

Column B shows the same relative information except in terms of dollar purchases of pulp, paper, and board, or products by other industries required for each million dollars of output of the other industries.

DIRECT WOOD PULP DISTRIBUTION

As would be expected, by far the largest direct purchaser of pulp mill products is the primary paper and board industry (sector no. 45) buying 82.5% of the total supply. Following in order of importance are synthetic fibers (no. 52) using 7%; exports (no. 225) nearly 2%; industrial organic chemicals (no. 49), 1.4%; plastics (no. 50), 1.3%; with the balance distributed to about a dozen other groups. It should be noted that the total supply of products of the pulp mills includes not only wood pulp but also secondary by-products such as tall oil and turpentine. Furthermore, the total "supply" of pulp mill products as indicated previously consists of production plus imports plus any withdrawals from inventory. On the other hand, exports and inventory additions are distribution outlets comparable to industrial buyers and Government.

For every million dollars of output of paper and board mills, column B discloses that $353,321 of pulp mill products are required. For every million dollars of synthetic fiber production, $117,123 of pulp mill products are used; in similar comparison, plastic materials require $25,793 of pulp; and even for medical and dental instruments and supplies (sector no. 155), $8399 of pulp mill products are utilized. Knowledge of the industry makes it possible to identify this as pulp for medical supplies used largely in sanitary napkins and surgical dressings.

DIRECT PAPER AND BOARD DISTRIBUTION

The direct distribution of primary paper and board also discloses a generally known situation but nevertheless more precisely shows that paper and board converting industries (sector no. 46) use about 46% of the total output; that printing and publishing (no. 47) uses about 29%; while the balance of 25% goes in varying percentages to a very wide range of other industries. These other industries, nevertheless, are truly important factors in the aggregate as markets for primary paper and board. For example, the concrete and plaster products industry (no. 74) purchases $30 million of paper and board, while banking, finance, and insurance (no. 181) purchase $27 million. Retail trade (no. 177), as a service industry, purchased $103 million of paper and board as a medium for handling retail transactions even though many products to retailers already packaged.

CONVERTED PRODUCTS DISTRIBUTION

The direct distribution of converted paper and board products discloses an even wider range of purchasing groups than in either the case of wood pulp or primary paper and board. For the first time, households (sector no. 200) enter the picture of direct purchases of the industry, amounting to 10½% of the total value of converted products. Obviously, households (individual people or families) do not buy wood pulp or primary paper or board. But they do buy but such items as household rolls of toilet tissue, paper towels, stationery, facial tissue, paper napkins, and similar products.

Two other important direct purchasers for converted products are wholesale (no. 176) and retail (no. 177) trade, taking 8 and 11%, respectively, of the total output of the industry. It must be kept in mind that the converted paper and board products industries encompass all types of items (except printing and publishing), such as bags, shipping sacks, folding and setup boxes, fiber shipping containers, waxed paper, as well as such types as sanitary paper products, stationery, envelopes, waterproof papers, etc. As was the case in primary paper and board, wholesale and retail establishments purchase important quantities of converted products for their own needs in merchandising. In this connection, it is apparent that wholesalers and retailers require bags and boxes for the handling and delivery of merchandise. The operation of a retail grocery or department store would be good examples of the utilization of boxes and bags in handling transactions. It must be recalled, however, that when the wholesaler or retailer sells such items as drugs, breakfast cereals, frozen foods, cigarettes, and the hundreds of other products which are packaged at the primary manufacturing plant, the direct sales of such packaging material are credited to these various primary manufacturers and not to the wholesaler or retailer.

Other major industry group buyers of converted products are printing and publishing (no. 47), 5.2%; bakery products (no. 25), 3.8%; medical and dental instruments and supplies (no. 155), 1.2%; eating and drinking places (no. 180), 1.8%; and laundries and dry cleaning (no. 184), 1.4%. The export market (no. 225) accounts for about $67 million, or 1.9% of the total distribution of converted products supply.

In terms of dollars of converted paper and board products purchased per million dollars of output of other industry groups, it is particularly significant to find that medical and dental supplies use $102,908 of paper products; toys and sporting goods (no. 159), $38,434; soap and related products (no. 55), $42,775; glass (no. 70), $58,409; cement (no. 71), $65,058; and cutlery (no. 94), $41,757. These figures indicate

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that paper products, particularly bags, boxes, and envelopes, account for from about 4 to 10% of the final value of output of such other products.

FINAL DEMAND FACTORS

Final demand purchases refer to the sale of commodities to ultimate consumers, such as households, the Federal Government, state or local governments, and exports. Additions to inventories are also classified as final demand. There are many industries which produce predominantly consumer goods, such as automobiles, furniture, processed food products, apparel, etc., while other industries (such as converted paper products) sell a moderate portion of their production directly to final demand, other industries (such as wood pulp) sell little or nothing to consumers.

Input-output statistics provide a basis for determining how much of the production of a sector which sells to other processing industries is related in the final analysis to demand by consumers, Government, investors, and foreign buyers for particular classes of finished goods. This relationship is an extremely important one.

To give an example, the consumer will buy and wear a garment. He will use this garment without further processing and without any intention of handing it on for resale. In supplying the consumer with the garment, the clothing wholesalers and retailers use paper, paperboard, boxes, bags, and other materials in their merchandising operations. The apparel industry will purchase textiles, paper and paperboard, boxes for packaging, and other materials, such as buttons, thread, metal fasteners, etc. The textile industry in turn may purchase cotton, rayon, or other fibers which are also frequently packaged in paper or paperboard. The rayon itself was largely made from wood pulp. But these latter purchases are engaged in only to satisfy the consumer with a garment, and in making them the wholesaler, retailer, and the garment and textile industries effectively act as agents for the consumer. Therefore, although the consumer himself is interested only in the purchase of a garment, his effective desire for apparel may be regarded as the driving force behind at least some production of wood pulp, paper, paperboard, boxes, cotton, etc. It is in establishing the remote demand interconnections of this type that the interindustry relations approach makes its contribution to marketing research.

As pointed out previously, a distinguishing feature of primary paper and paperboard, as well as the major tonnage output of converted products, is that such a large proportion goes to other processing sectors and so little to final demand. Effectively, the primary paper and paperboard industry has almost no final consumers in the United States who wish to use its product in the form it leaves the mill. The only really significant final demand entries are for exports of paper and paperboard and Government purchases. Furthermore, only 14% of the total volume of all types of converted paper and board products is purchased by final consumers who wish to use the item as such. For example, ultimate consumers do not buy paperboard shipping containers, folding or setup boxes and multiwall bags, but they do purchase direct such items as toilet paper and stationery. In the case of newspapers, books, and magazines, the consumer is not buying paper, but rather purchasing reading material.

Nevertheless, the ultimate purchasers of the economy require a large amount and variety of finished goods in which paper, paperboard, and products are used in wrapping and packaging, as a medium for printing, or perhaps as an integral part of some other products. The purpose of economic activity is not just production for its own sake, but rather to place finished goods in the hands of those who will use them.

FINAL DEMAND RELATIONSHIP TO PULP, PAPER AND BOARD, AND PRODUCTS

Column C of the table shows for each million dollars of domestic output of processing industries going directly to final demand the direct and indirect dollar requirements of pulp, paper and board, and products. These data, compiled by the Bureau of Labor Statistics, serve as the basis for computations of the total direct and indirect requirements of pulp, paper and board, and products purchased by other industries whose products go direct to final demand, as shown in column E. The multiplication factors, namely the total domestic output of manufacturing industries going directly to final demand, are shown in column D.

To follow this procedure, let us take the apparel industry (sector no. 34) as a specific example. Column C shows that for every million dollars of the product going directly to final demand, the apparel industry required directly and indirectly $7773 of wood pulp, $8937 of primary paper and board, and $13,264 of paper and board products. Next, column D shows that the total sales of apparel going to final demand was $9484 million. Multiplying $9484 million by the $7773 of wood pulp required per million dollars results in disclosing that $74 million of wood pulp was necessary to consummate the production and sale of apparel to final demand. In similar comparison, $85 million of paper and board and $127 million of paper and board products are used directly and indirectly in the manufacturing processes and distribution of apparel to final consumers.

The significance of the final demand effects upon the pulp, paper, board, and products industries is clearly demonstrated in this example of apparel. The following tabulation shows that the apparel industry does not buy any pulp or paper and board *directly* from pulp,

Effect of Final Demands for Products of Certain Industries on Requirements for Pulp, Paper and Board and Converted Products

(Millions of Dollars)

Sector No.	Industry	From— Pulp mills	Paper and board mills	Converted products mfrs.
34	Apparel industry			
	Direct purchases	...	...	75.7
	Direct and indirect requirements to meet final demand	73.7	84.8	126.7
52	Synthetic fiber industry			
	Direct purchases	85.1	...	4.0
	Direct and indirect requirements to meet final demand	2.4	0.1	0.2
145	Motor vehicles industry			
	Direct purchases	...	4.2	27.4
	Direct and indirect requirements to meet final demands	26.2	62.0	74.1

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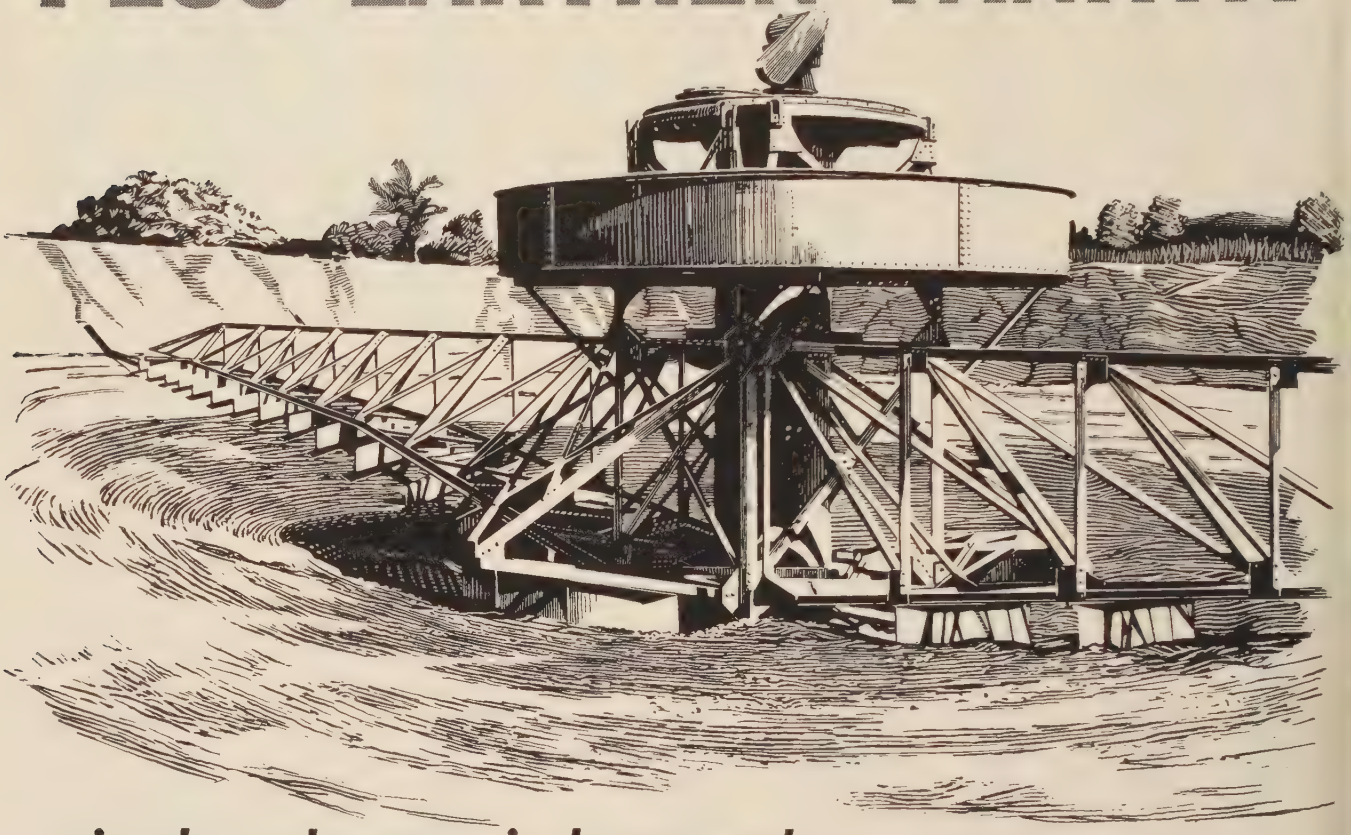
BLS Sector No.	Purchasing sectors	Column A: Direct distribution of supply of — Pulp mills: Million dollars	Pulp mills: Per cent of total	Paper and board mills: Million dollars	Paper and board mills: Per cent of total	Converted products Mfrs.: Million dollars	Converted products Mfrs.: Per cent of total	Column B: Each million dollars of output of processing industries required the following direct purchases from — Pulp mills, dollars	Paper and board mills, dollars	Converted products mfrs., dollars
	Processing Industries									
9	All other agricultural	...	...	1.6	[a]	...	...	...	808	...
16	Coal mining	...	...	...	...	0.2	[a]	...	..	69
18	Stone, sand, clay, and abrasives	...	...	...	...	7.2	0.2	...	...	11,374
19	Sulphur	...	...	...	...	0.6	[a]	...	...	7,535
20	Other nonmetallic minerals	...	...	...	...	3.9	0.1	...	...	23,454
21	Meat packing and wholesale poultry	...	...	0.1	[a]	5.8	0.2	...	9	521
22	Processed dairy products	...	...	3.2	0.1	79.6	2.3	...	876	21,824
23	Canning, preserving, and freezing	...	...	...	...	84.3	2.4	...	...	30,949
24	Grain mill products	...	...	5.0	0.2	64.5	1.9	...	936	12,065
25	Bakery products	...	...	...	...	132.1	3.8	...	...	39,409
26	Miscellaneous food products	...	...	2.2	[a]	175.5	5.0	...	336	26,458
27	Sugar	...	...	...	...	10.2	0.3	...	...	8,650
28	Alcoholic beverages	...	[a]	...	...	47.4	1.4	...	...	17,386
29	Tobacco manufactures	...	...	14.5	0.4	67.3	1.9	...	5,653	26,242
30	Spinning, weaving, and dyeing	0.1	[a]	...	...	30.6	0.9	11	...	3,780
31	Special textile products	...	...	...	...	10.1	0.3	...	...	12,235
32	Jute, linen, cordage, and twine	...	...	...	...	2.1	[a]	...	..	8,258
34	Apparel	...	...	...	...	75.7	2.2	...	...	6,677
35	House furnishing and other nonapparel	0.6	[a]	15.9	0.5	7.7	0.2	313	8,794	4,241
37	Sawmills, planing and veneer mills	...	...	0.5	[a]	...	...	...	156	...
39	Fabricated wood products	...	...	1.6	[a]	...	...	...	1,573	
40	Wood containers and cooperage	...	...	2.9	[a]	...	...	...	4,993	...
41	Wood furniture	...	...	..	...	3.3	[a]	...	...	2,239
42	Metal furniture	...	...	...	...	14.1	0.4	...	...	16,154
43	Partitions, screens, shades, etc.	...	...	1.0	[a]	...	...	...	1,725	...
44	Pulp mills	3.0	0.3	...	...	...	...	3,161	...	...
45	Paper and board mills	997.5	82.5	...	...	7.8	0.2	353,321	1,014	2,750
46	Converted paper and board products	8 8	0.7	1472.3	45.8	95.7	2 8	2,586	432,538	32,971
47	Printing and publishing	...	...	945.0	29.4	180.9	5.2	...	144,219	27,612
48	Industrial inorganic chemicals	2.7	0.2	0.8	[a]	7.2	0.2	2,460	768	6,580
49	Industrial organic chemicals	16.3	1.4	2.0	[a]	3.7	0.1	9,769	1,196	2,197
50	Plastics materials	15.3	1.3	8.9	0.3	17.9	0.5	25,793	14,971	30,155
51	Synthetic rubber	...	...	...	...	2.4	[a]	...	...	9,409
52	Synthetic fiber	85.1	7.0	...	...	4.0	0.1	117,123	...	5,507
53	Explosives and fireworks	0.8	[a]	1.6	[a]	0.6	[a]	4,836	10,264	3,766
54	Drugs and medicines	...	...	...	...	40.6	1.2	...	...	32,007
55	Soap and related products	1.2	0.1	...	...	65.6	1.9	774	...	42,775
56	Paints and allied products	1.9	0.2	...	...	19.1	0.6	1,153	...	11,724
57	Gum and wood chemicals	...	...	...	...	0.3	[a]	...	...	2,012
58	Fertilizers	...	...	...	...	22.5	0.7	...	...	43,096
59	Vegetable oils	...	...	...	...	0.1	[a]	...	...	59
61	Miscellaneous chemical industries	...	...	...	...	60.6	1.7	...	...	36,980
62	Petroleum products	0.1	[a]	...	...	5.2	0.1	14	...	692
63	Coke and products	...	...	0.1	[a]	0.1	[a]	...	79	79
64	Paving and roofing materials	...	...	102.0	3.2	0.2	[a]	...	251,527	496
65	Tires and tubes	...	...	...	...	8.1	0.2	...	...	4,868
66	Miscellaneous rubber products	...	...	...	...	28.0	0.8	...	...	20,956
68	Miscellaneous leather products	...	...	0.4	[a]	8.3	0.2	...	767	15,446
69	Footwear (excl. rubber)	...	...	12.9	0.4	46.8	1.4	...	6,082	22,160
70	Glass	...	...	12.7	0.4	67.3	1.9	...	11,012	58,409
71	Cement	...	...	...	...	26.7	0.8	...	...	65,058
73	Pottery and related products	...	...	...	...	7.3	0.2	...	...	23,244
74	Concrete and plaster products	...	...	30.2	0.9	12.7	0.4	...	48,246	20,313
75	Abrasive products	...	...	4.0	0.1	1.0	[a]	...	15,114	3,920
76	Asbestos products	...	...	1.1	[a]	5.8	0.2	...	3,085	16,068
77	Miscellaneous nonmetallic minerals	...	...	...	...	3.1	[a]	...	...	11,987
78	Blast furnaces	...	...	...	...	0.5	[a]	...	...	251
93	Tin cans and other tinware	...	...	5.1	0.2	17.0	0.5	...	7,309	24,442
94	Cutlery	...	...	...	...	6.3	0.2	...	...	41,757
95	Tools and general hardware	...	...	0.4	[a]	2.5	[a]	...	893	5,169
96	Other hardware	...	...	0.3	[a]	14.0	0.4	...	475	22,014
97	Metal plumbing and vitreous fixtures	...	...	0.6	[a]	3.0	[a]	...	1,478	7,327
98	Heating equipment	...	...	1.0	[a]	5.4	0.2	...	722	3,813
99	Structural metal products	...	...	0.8	[a]	4.2	0.1	...	491	2,561
101	Metal stampings	...	...	6.3	0.2	13.2	0.4	...	4,536	9,489
103	Lighting fixtures	...	...	0.7	[a]	12.9	0.4	...	1,377	24,571
104	Fabricated wire products	...	...	0.5	[a]	1.6	[a]	...	559	1,822
106	Tubes and foils	...	...	2.4	[a]	...	...	...	27,042	...
109	Nuts, bolts, and screw Mach. Prod.	...	...	...	[a]	1.0	[a]	...	...	1,287
111	Internal combustion engines	...	...	0.1	[a]	2.5	[a]	...	130	3,035
112	Farm and industrial tractors	...	...	0.1	[a]	...	[a]	...	115	...
113	Farm equipment	...	...	0.2	[a]	1.1	[a]	...	172	1,171
114	Construction and mining machinery	...	...	0.1	[a]	...	[a]	...	90	...
115	Oil field machinery	...	...	...	[a]	0.5	[a]	...	...	1,707
116	Machine tools and metal-working machinery	...	...	0.3	[a]	1.4	[a]	...	308	1,236
117	Cutting tools, jigs, and fixtures	...	...	0.1	...	0.5	[a]	...	114	710
118	Special industrial machinery	...	...	3.5	0.1	10.7	0.3	...	1,733	5,291
119	Pumps and compressors	...	...	...	...	0.3	[a]	...	...	419

Column C: Each million dollars of final demand deliveries by processing industries required (directly and indirectly), domestic production of—			Column D, direct deliveries of domestic production of processing industries to final demand,[b] million dollars	Column E: Final demand[b] deliveries by processing industries required (directly and indirectly) domestic production of—						
				Pulp mills		Paper and board mills		Converted products mfrs.		
Pulp mills, dollars	Paper and board mills, dollars	Converted products mfrs., dollars		Million dollars	Per cent of total	Million dollars	Per cent of total	Million dollars	Per cent of total	BL Sector No.
1,191	3,037	2,431	619.4	0.7	[a]	1.9	[a]	1.5	[a]	9
593	1,248	1,177	444.0	0.3	[a]	0.6	[a]	0.5	[a]	16
2,655	6,778	13,415	382.2	1.0	0.1	2.6	[a]	5.1	0.1	18
1,347	3,683	8,099	25.3	[a]	[a]	0.1	[a]	0.2	[a]	19
4,588	12,046	25,540	(−65.9)	(−0.3)	[a]	(−0.8)	[a]	(−1.7)	[a]	20
1,535	3,455	4,500	8,950.0	13.7	1.4	30.9	1.1	40.3	1.2	21
6,203	16,882	31,521	2,443.3	15.1	1.6	41.2	1.5	77.0	2.3	22
9,121	24,861	42,610	2,111.3	19.2	2.0	52.5	1.9	90.0	2.6	23
4,944	12,923	18,678	1,695.2	8.4	0.9	21.9	0.8	31.7	0.9	24
9,636	25,919	52,967	3,005.3	29.0	3.1	77.9	2.8	159.2	4.7	25
8,230	22,177	38,091	4,246.2	34.9	3.7	94.1	3.3	161.7	4.8	26
5,154	13,760	24,053	(−225.4)	(−1.2)	(−0.1)	(−3.1)	[a]	(−5.4)	(−0.2)	27
7,532	20,251	28,879	1,207.0	9.1	0.9	24.4	0.9	34.9	1.0	28
13,182	35,672	46,101	1,682.3	22.2	2.3	60.0	2.1	77.5	2.3	29
10,751	5,035	7,855	1,991.0	21.4	2.2	10.0	0.4	15.6	0.5	30
5,126	9,487	17,009	472.0	2.4	0.2	4.5	0.2	8.0	0.2	31
4,259	5,816	11,642	56.3	0.2	[a]	0.3	[a]	0.7	[a]	32
7,773	8,937	13,264	9,483.5	73.7	7.8	84.8	3.0	126.7	3.7	34
11,311	16,707	11,736	1,097.6	12.4	1.3	18.3	0.6	12.9	0.4	35
937	2,329	1,592	1,822.0	1.7	0.2	4.2	0.1	2.9	[a]	37
2,044	5,355	2,932	715.0	1.5	0.1	3.8	0.1	2.1	[a]	39
2,945	8,018	1,860	35.1	0.1	[a]	0.3	[a]	[a]	[a]	40
3,039	6,330	7,977	1,260.6	3.8	0.4	8.0	0.3	10.0	0.3	41
6,403	14,588	22,846	696.7	4.5	0.5	10.2	0.4	15.9	0.5	42
4,875	11,185	6,845	406.5	2.0	0.2	4.5	0.1	2.8	[a]	43
1,004,537	2,579	2,093	(−192.9)	(−193.8)	(−20.5)	(−0.5)	[a]	(−0.4)	[a]	44
356,654	1,005,194	6,024	(−127.7)	(−45.5)	(−4.8)	(−128.4)	(−4.5)	(−0.8)	[a]	45
163,826	452,806	1,038,996	511.8	83.8	8.9	231.7	8.2	531.8	15 6	46
64,588	181,503	35,414	1,805.1	116.6	12.3	327.6	11.6	63.9	1.9	47
7,335	9,070	13,558	159.4	1.1	0.1	1.4	[a]	2.2	[a]	48
15,943	8,253	10,090	209.4	3.3	0.3	1.7	[a]	2.1	[a]	49
44,793	36,764	41,070	63.1	2.8	0.3	2.3	[a]	2.6	.	50
6,718	10,635	18,024	(−323.3)	(−2.2)	(−0.2)	(−3.4)	(−0.1)	(−5.8)	(−0 2)	51
121,558	6,060	9,495	19.9	2.4	0.3	0.1	[a]	0.2	[a]	52
13,077	19,652	13,830	48.3	0.6	[a]	0.9	[a]	0.7	[a]	53
13,420	33,885	46,337	728.8	9.8	1.0	24.7	0.9	33.8	1.0	54
15,459	36,748	56,015	975.4	15.1	1.6	35.8	1.3	54.6	1.6	55
9,701	13,879	21,884	794.8	7.7	0.8	11.0	0.4	17.4	0.5	56
1,967	4,059	5,244	32.2	0.1	[a]	0.1	[a]	0.2	[a]	57
10,970	27,043	57,170	18.3	0.2	[a]	0.5	[a]	1.0	[a]	58
2,498	6,142	9,256	(−29.3)	(−0.1)	[a]	(−0.2)	[a]	(−0.3)	[a]	59
15,885	37,583	53,802	560.9	8.9	0.9	21.1	0.7	30.2	0.9	61
1,078	2,221	2,149	3,423.0	3.6	0.4	7.6	0.3	7.4	0.2	62
1,737	4,252	1,771	44.9	0.1	[a]	0.2	[a]	0.1	[a]	63
91,093	256,217	4,940	383.8	35.0	3.7	98.3	3.5	1.9	[a]	64
6,290	9,437	14,651	661.3	4.1	0.4	6.2	0.2	9.7	0.3	65
7,346	15,424	29,431	417.2	3.0	0.3	6.4	0.2	12.3	0.4	66
6,626	13,992	22,110	438.3	2.9	0.3	6.1	0.2	9.7	0.3	68
8,744	22,698	30,113	1,811.7	15.8	1.7	41.1	1.5	54.5	1.6	69
16,295	43,996	67,919	364.0	5.9	0.6	16.0	0.6	24.7	0.7	70
11,238	30,878	69,114	343.4	3.9	0.4	10.6	0.4	23.7	0.7	71
5,299	13,922	27,567	219.1	1.1	0.1	3.0	0.1	6.0	0.2	73
23,388	64,920	31,132	536.8	12.6	1.3	34.8	1.2	16.7	0.5	74
10,115	24,600	11,165	24.9	0.2	[a]	0.6	[a]	0.3	[a]	75
6,981	16,569	25,448	142.8	1.0	0.1	2.4	[a]	3.6	0.1	76
4,213	10,830	18,243	44.9	0.2	[a]	0.5	[a]	0.8	[a]	77
1,194	2,891	2,091	(−2.8)	[a]	[a]	[a]	[a]	[a]	[a]	78
8,215	22,200	29,344	37.2	0.3	[a]	0.8	[a]	1.0	[a]	93
9,456	25,275	47,463	125.8	1.2	0.1	3.2	0.1	6.0	0.2	94
2,462	6,504	8,693	156.5	0.4	[a]	1.0	[a]	1.4	[a]	95
4,929	13,313	26,293	223.0	1.1	0.1	3.0	0.1	5.9	0.2	96
3,385	8,940	12,112	322.7	1.1	0.1	2.9	0.1	3.9	0.1	97
3,078	8,131	8,777	1,134.1	3.5	0.4	9.2	0.3	10.0	0.3	98
1,823	4,781	5,727	1,336.7	2.4	0.3	6.4	0.2	7.6	0.2	99
5,635	15,121	14,786	268.4	1.5	0.2	4.0	0.1	3.9	0.1	101
7,831	20,588	34,073	323.7	2.5	0.3	6.7	0.2	11.0	0.3	103
1,645	4,177	4,122	351.0	0.6	[a]	1.5	[a]	1.4	[a]	104
12,365	33,687	3,526	13.7	0.1	[a]	0.5	[a]	[a]	[a]	106
1,259	3,314	3,714	108.3	0.1	[a]	0.4	[a]	0.4	[a]	109
1,851	4,760	6,665	259.6	0.5	[a]	1.2	[a]	1.7	[a]	111
1,700	4,142	4,100	819.5	1.4	0.1	3.4	0.1	3.4	0.1	112
1,829	4,494	4,719	810.3	1.5	0.2	3.6	0.1	3.8	0.1	113
1,287	3,184	3,340	794.8	1.0	0.1	2.5	[a]	2.7	[a]	114
1,490	3,802	4,861	267.5	0.4	[a]	1.0	[a]	1.3	[a]	115
1,495	3,848	4,047	815.7	1.2	0.1	3.1	0.1	3.3	0.1	116
1,339	3,438	3,580	115.9	0.2	[a]	0.4	[a]	0.4	[a]	117
2,750	7,037	8,507	1,591.4	4.4	0.5	11.2	0.4	13.5	0.4	118
1,731	4,416	4,166	424.9	0.7	[a]	1.9	[a]	1.8	[a]	119

DORR CLARIFIER

PLUS EARTHEN TANK...



simple and economical approach to pulp mill waste treatment

If removal of settleable solids from large flows is your principal waste treatment worry, this is your combination for economy. A Dorr Clarifier installed in an earthen tank will give you substantial removals of suspended solids and effect reasonable BOD reduction as well — at a lower installed cost than any other available unit.

The principle of installing a Dorr mechanism in an oversized earthen basin has been thoroughly proven in sedimentation operations in many industries. And now . . . three Southeastern kraft mills are adapting it for waste treatment. These particular installations range in size from a 150′ dia. Clarifier installed in a 250′ dia. basin to a 300′ dia. unit installed in a 500′ dia. tank.

While the Dorr Clarifier-earthen basin team is suited principally for use as a primary treatment unit, it's a sound starting point for eventual complete biological treatment as well. Additional treatment steps can be added as needed, without affecting the initial Clarifier installation.

We'd be glad to talk to you or your engineers about the details of this low cost combination in terms of your own problem. No obligation, of course. Just write to The Dorr Company, Barry Place, Stamford, Conn.

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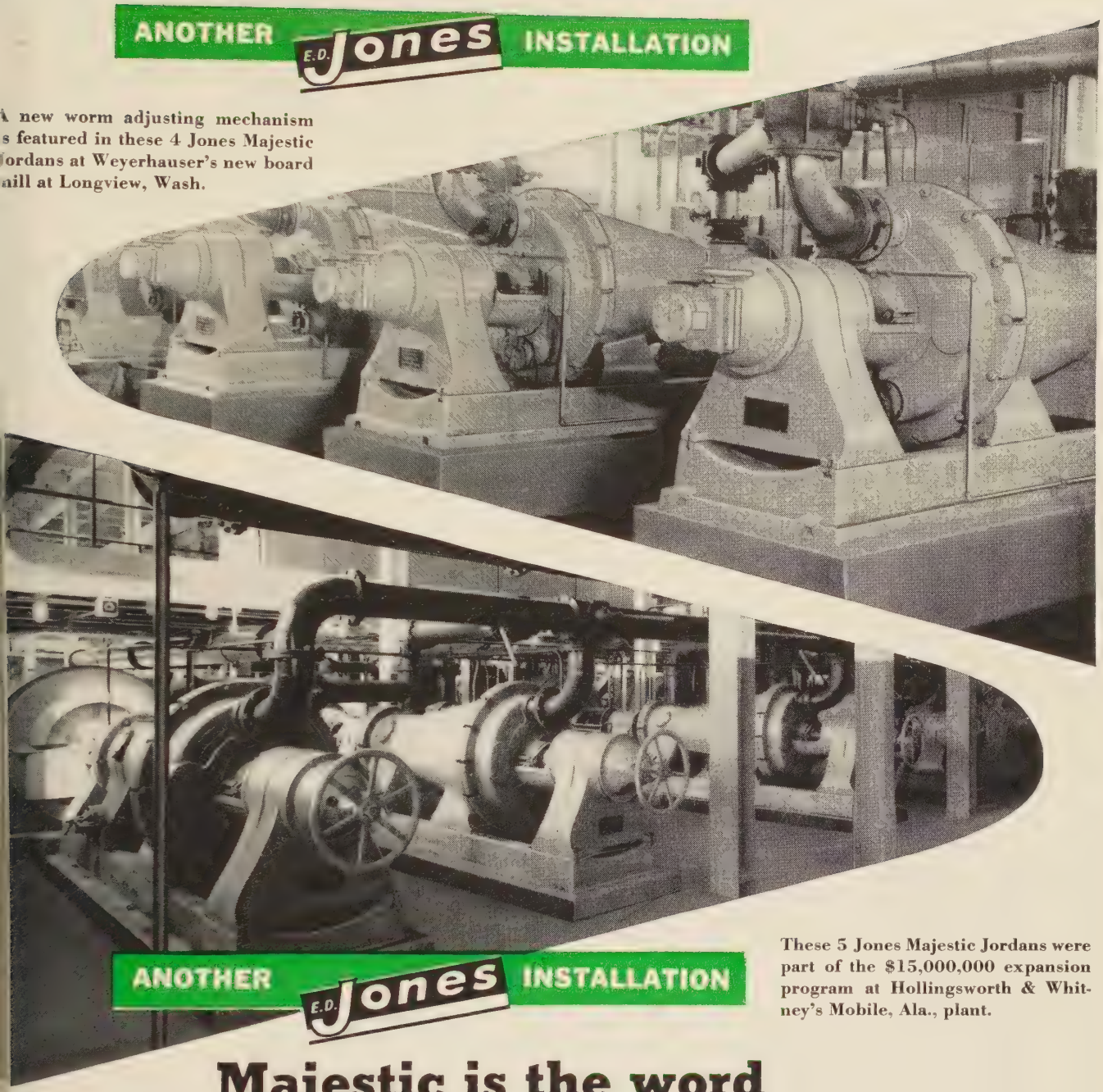
ANOTHER E.D. Jones INSTALLATION

A new worm adjusting mechanism is featured in these 4 Jones Majestic Jordans at Weyerhauser's new board mill at Longview, Wash.



ANOTHER E.D. Jones INSTALLATION

These 5 Jones Majestic Jordans were part of the $15,000,000 expansion program at Hollingsworth & Whitney's Mobile, Ala., plant.

Majestic is the word for these Jordans

The Majestic is only one of the many sizes in which Jones Jordans are made. But such is the popularity of this high-capacity work horse that it accounts for 25% of the Jones Jordans sold to date. Like all Jones Jordans it incorporates exclusive features developed from our more-than-a-century of service to paper mills. For more details, ask your Jones representative or write for Bulletin 1007-A.

E.D. Jones

E. D. Jones & Sons Company, Pittsfield, Mass.

BUILDERS OF QUALITY STOCK PREPARATION MACHINERY

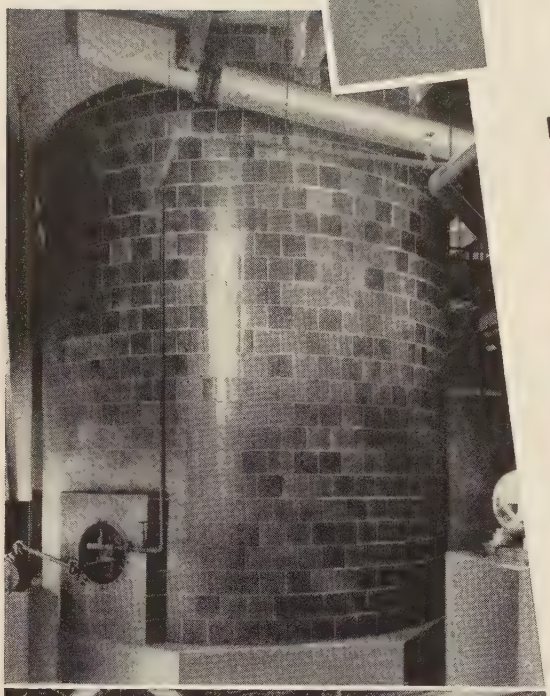
BLS Sector No.	Purchasing sectors	Column A: Direct distribution of supply of — Pulp mills: Million dollars	Pulp mills: Per cent of total	Paper and board mills: Million dollars	Paper and board mills: Per cent of total	Converted products mfrs.: Million dollars	Converted products mfrs.: Per cent of total	Column B: Each million dollars of output of processing industries required the following direct purchases from — Pulp mills, dollars	Paper and board mills, dollars	Converted products mfrs., dollars
120	Elevators and conveyors	...	...	0.1	[a]	...	[a]	...	214	...
121	Blowers and fans	...	...	...	[a]	0.3	[a]	...	...	1,971
122	Power transmission equipment	...	...	0.4	[a]	2.0	[a]	...	767	3,947
123	Miscellaneous industrial machinery	...	...	0.6	[a]	0.2	[a]	...	1,058	339
124	Miscellaneous commercial machinery and equipment	...	...	4.0	0.1	5.3	0.2	...	3,840	5,132
125	Refrigeration equipment	...	...	3.1	0.1	8.1	0.2	...	2,063	5,452
126	Valves and fittings	...	...	0.1	[a]	1.6	[a]	...	109	2,316
127	Ball and roller bearings	...	...	0.1	[a]	0.4	[a]	...	160	1,088
129	Wiring devices and graphite prod.	...	...	1.0	[a]	3.6	0.1	...	1,960	7,000
130	Electric measuring instruments	...	...	0.8	[a]	1.4	[a]	...	4,082	7,698
131	Motors and generators	...	...	0.8	[a]	3.3	[a]	...	744	3,019
132	Transformers	...	...	6.5	0.2	0.6	[a]	...	16,664	1,620
133	Electrical control apparatus	...	...	0.7	[a]	4.5	0.1	...	947	6,381
134	Electrical welding apparatus	...	...	3.9	0.1	1.0	[a]	...	15,790	4,008
135	Electrical appliances	...	...	2.3	[a]	9.3	0.3	...	1,520	6,106
136	Insulated wire and cable	...	...	6.4	0.2	0.3	[a]	...	6,381	309
137	Engine electrical equipment	...	...	0.7	[a]	3.1	[a]	...	1,731	8,031
138	Electric lamps	...	...	0.8	[a]	1.6	[a]	...	2,545	5,090
139	Radio and related products	...	...	6.5	0.2	11.2	0.3	...	4,036	6,924
140	Tubes, radio, etc.	...	...	...	...	1.8	[a]	...	...	13,373
141	Communication equipment	...	...	0.7	[a]	2.2	[a]	...	837	2,788
142	Storage batteries	...	...	...	[a]	0.1	[a]	...	...	429
143	Primary batteries	...	...	0.8	[a]	0.6	[a]	...	9,217	6,913
144	X-ray apparatus	...	...	...	...	0.2	[a]	...	.....	2,412
145	Motor vehicles	...	...	4.2	0.1	27.4	0.8	...	335	2,190
147	Automobile trailers	...	...	1.8	[a]	...	...	...	12,967	...
148	Aircraft and parts	...	...	...	...	13.3	0.4	...	...	8,307
149	Ships and boats	...	...	3.7	0.1	...	...	...	3,923	...
152	Motor cycles and bicycles	...	...	...	...	3.1	[a]	...	...	12,535
153	Instruments, etc.	...	...	0.5	[a]	2.9	[a]	...	946	5,006
154	Optical, ophthalmic, and photo equipment	...	...	9.0	0.3	10.3	0.3	...	14,442	16,477
155	Medical and dental instruments and supplies	3.3	0.3	13.8	0.4	40.5	1.2	8,399	35,209	102,908
156	Watches and clocks	...	...	0.1	[a]	2.7	[a]	...	307	6,843
157	Jewelry and silverware	...	...	...	...	5.0	0.1	...	...	6,609
158	Musical instruments and parts	...	...	...	...	0.2	[a]	...	...	1,454
159	Toys and sporting goods	...	...	...	...	23.1	0.7	...	...	38,434
160	Office supplies	...	...	7.7	0.2	2.1	[a]	...	25,757	7,139
161	Plastic products	...	...	10.5	0.3	5.6	0.2	...	19,180	10,282
163	Motion picture production	...	...	0.7	[a]	0.5	[a]	...	1,499	1,187
164	Miscellaneous manufactured products	...	...	43.8	1.4	87.8	2.5	...	21,247	42,527
167	Electric light and power	1.1	[a]	2.3	[a]	...	...	255	511	...
169	Railroads	...	...	2.9	[a]	0.6	[a]	...	290	62
171	Warehousing and storage	...	...	...	...	4.2	0.1	...	...	7,796
172	Overseas transportation	...	...	...	...	0.4	[a]	...	...	211
173	Other water transportation	...	...	...	...	0.2	[a]	...	...	215
174	Air transportation	...	...	...	...	0.3	[a]	...	...	366
175	Pipe-line transportation	...	...	...	...	0.2	[a]	...	...	514
176	Wholesale trade	0.1	[a]	...	...	274.1	7.9	9	...	17,024
177	Retail trade	...	...	103.1	3.2	396.2	11.4	...	4,018	15,440
178	Local and highway transportation	...	...	...	...	0.5	[a]	...	...	153
179	Telephone and telegraph	...	...	...	...	2.2	[a]	...	...	792
180	Eating and drinking places	...	...	...	...	61.0	1.8	...	...	4,598
181	Banking, finance, and insurance	...	...	26.8	0.8	26.5	0.8	...	2,115	2,088
182	Hotels	...	...	...	...	0.5	[a]	...	...	339
183	Real estate and rentals	...	...	...	...	60.0	1.7	...	...	2,075
184	Laundries and dry cleaning	...	...	...	...	49.0	1.4	...	...	24,284
185	Other personal services	...	...	...	...	9.2	0.3	...	...	3,821
186	Advertising, incl. radio and TV	...	...	...	...	2.8	[a]	...	...	735
187	Business services	...	...	1.5	[a]	...	[a]	...	1,186	...
188	Automobile repairs, garages, etc.	...	...	...	...	1.3	[a]	...	...	337
189	Other repair services	...	...	...	...	[a]	[a]	...	...	88
190	Motion pictures and other amusements	...	...	...	...	1.8	[a]	...	...	609
191	Medical, dental, and other professional services	...	...	...	...	16.0	0.5	...	...	1,783
192	Nonprofit institutions	...	...	10.3	0.3	10.7	0.3	...	1,406	1,450
	Miscellaneous processing industries	...	...	...	...	...	...	...	...	...
	All Others									
951	Small arms	...	...	...	...	0.2	[a]			
961	Small arms ammunition	...	...	5.6	0.2	0.5	[a]			
212	Maintenance and construction	...	...	30.6	1.0	50.2	1.4			
211	New construction	...	...	61.5	1.9	27.8	0.8			
266	Waste products—nonmetal	...	...	2.9	[a]	16.5	0.5			
225	Exports	22.3	1.8	73.4	2.3	66.8	1.9			
215	Federal Government	0.1	[a]	12.9	0.4	19.2	0.6			
220	State and local government	...	[a]	0.1	[a]	31.5	0.9			
235	Inventory additions, by producer	4.3	0.4	9.0	0.3	20.4	0.6			
230	Inventory additions, by all other	44.3	3.7	70.5	2.2	1.6	0.5			
200	Households	...	...	...	...	364.6	10.5			

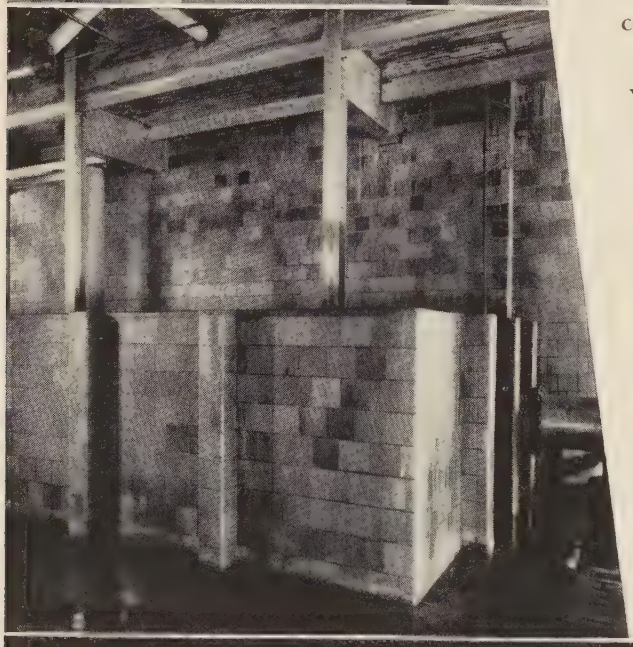
Note

Column C — Each million dollars of final demand deliveries by processing industries required (directly and indirectly), domestic production of—			Column D, direct deliveries of domestic production of processing industries to final demand,[b] million dollars	Column E — Final demand[b] deliveries by processing industries required (directly and indirectly) domestic production of—						BLS Sector No.
				Pulp mills		Paper and board mills		Converted products mfrs.		
Pulp mills, dollars	Paper and board mills, dollars	Converted products mfrs., dollars		Million dollars	Per cent of total	Million dollars	Per cent of total	Million dollars	Per cent of total	
1,420	3,535	3,195	298.5	0.4	[a]	1.0	[a]	1.0	[a]	120
1,839	4,723	5,712	103.2	0.2	[a]	0.5	[a]	0.6	[a]	121
2,153	5,174	6,731	29.8	[a]	[a]	0.1	[a]	0.2	[a]	122
2,205	5,510	4,618	405.4	0.9	[a]	2.2	[a]	1.9	[a]	123
4,034	10,629	8,975	847.1	3.4	0.4	9.0	0.3	7.6	0.2	124
4,495	11,704	11,840	1,113.0	5.0	0.5	13.0	0.5	13.1	0.4	125
1λ406	3,597	4,855	261.4	0.4	0.4	0.9	[a]	1.3	[a]	126
1,044	2,711	2,734	40.0	[a]	[a]	0.1	[a]	0.1	[a]	127
5,159	11,238	13,396	272.4	1.4	0.1	3.0	0.1	3.6	1.1	129
5,616	14,401	13,482	143.1	0.8	[a]	2.1	[a]	1.9	[a]	130
2,754	6,496	7,187	363.1	1.0	0.1	2.4	[a]	2.6	[a]	131
8,344	22,428	5,763	260.8	2.2	0.2	5.8	0.2	1.5	[a]	132
4,106	8,879	11,590	442.5	1.8	0.2	3.9	0.1	5.1	0.2	133
9,004	24,234	10,979	149.9	1.3	0.1	3.6	0.1	1.6	[a]	134
4,829	12,134	12,704	1,275.6	6.2	0.7	15.5	0.5	16.2	0.5	135
4,862	10,802	4,188	540.2	2.6	0.3	5.8	0.2	2.3	[a]	136
3,909	9,936	12,550	24.1	0.1	[a]	0.2	[a]	0.3	[a]	137
5,859	15,350	16,781	160.2	0 9	[a]	2.4	[a]	2.7	[a]	138
6,148	15,761	13,996	1,138.6	7.0	0.7	17.9	0.6	15.9	0.5	139
4,753	11,197	19,518	27.8	0.1	[a]	0.3	[a]	0.5	[a]	140
3,371	7,526	7,534	567.1	1.9	0.2	4.3	0.2	4.3	0.1	141
3,134	5,915	7,710	34.5	0.1	[a]	0.2	[a]	0.3	[a]	142
5,753	15,188	10,323	73.2	0.4	[a]	1.1	[a]	0.8	[a]	143
2,464	6,102	6,700	49.9	0.1	[a]	0.3	[a]	0.3	[a]	144
3,588	8,470	10,135	7,316.5	26.2	2.8	62.0	2.2	74.1	2.2	145
9,078	24,362	7,750	135.8	1.2	0.1	3.3	[a]	1.0	[a]	147
3,063	8,085	12,387	1,342.0	4.1	0 4	10.9	0.4	16.6	0.5	148
2,924	7,599	3,274	663.2	1.9	0.2	5.0	0.2	2.2	[a]	149
3,780	9,784	18,490	166.9	0.6	[a]	1.6	[a]	3.1	[a]	152
4,228	10,487	12,499	300.2	1.3	0.1	3.1	0.1	3.7	0.1	153
12,141	31,260	25,322	371.5	4.5	0.5	11.6	0.4	9.4	0.3	154
44,208	96,249	115,612	217.7	9.6	1.0	21.0	0.7	25.2	0.7	155
5,568	14,391	16,725	228.5	1.3	0.1	3.2	0.1	3.8	0.1	156
4,171	11,207	12,668	636 2	2.7	0.3	7.1	0.3	8.0	0.2	157
4,119	10,309	6,976	97.4	0.4	[a]	1.0	[a]	0.6	[a]	158
11,185	27,964	47,887	502.4	5.6	0.6	14.0	0.5	24.1	0.7	159
14,101	37,888	13,963	149.4	2.1	0.2	5.7	0.2	2.1	[a]	160
19,100	36,136	22,609	164.4	3.1	0.3	5.9	0.2	3.7	0.1	161
2,029	5,358	3,666	364.1	0.7	[a]	2.0	[a]	1.3	[a]	163
30,468	81,702	57,276	579.0	17.6	1.9	47.3	1.7	33.2	1.0	164
814	1,348	619	294.7	0.2	[a]	0.4	[a]	0.2	[a]	167
789	2,077	1,210	4,689.2	3.7	0.4	9.7	0.3	5.7	0.1	169
2,808	7,606	11,080	255.1	0.7	[a]	1.9	[a]	2.8	[a]	171
1,155	3,024	2,080	1,785.8	2.1	0.2	5.4	0.2	3.7	0.1	172
1,504	3,921	2,504	321.8	0.5	[a]	1.3	[a]	0.8	[a]	173
1,688	4,551	3,183	718.8	1.2	0.1	3.3	0.1	2.3	[a]	174
540	1,408	1,098	19.9	[a]	[a]	[a]	[a]	[a]	[a]	175
4,744	12,993	20,044	10,104.6	47.9	5.1	131.3	4.7	202.5	5.9	176
6,569	18,189	18,935	23,764.2	156.1	16.5	432.2	15.3	450.0	13.2	177
907	2,281	2,002	2,976.3	2.7	0.3	6.8	0.2	6.0	0.2	178
1,254	3,431	1,962	1,485.2	1.9	0.2	5.1	0.2	2.9	[a]	179
3,558	9,584	15,377	13,105.5	46.6	4.9	125.6	4.4	201.5	5.9	180
4,102	11,394	5,303	7,502.6	30.8	3.3	85.5	3.0	39.8	1.2	181
1,852	4,778	3,527	1,388.0	2.6	0.3	6.6	0.2	4.9	0.1	182
842	2,223	3,196	21,374.8	18.0	1.9	47.5	1.7	68.3	2.0	183
6,183	16,471	29,126	1,483.6	9.2	1.0	24.4	0.9	43.2	1.3	184
4,677	12,463	12,704	2,314.9	10.8	1.1	28.9	1.0	29.4	0.9	185
40,493	113,545	25,327	102.5	4.1	0.4	11.6	0.4	2.6	[a]	186
2,731	7,464	3,057	299.3	0.8	[a]	2.2	[a]	0.9	[a]	187
2,081	5,056	6,471	2,212.7	4.6	0.5	11.2	0.4	14.3	0.4	188
2,016	5,139	4,347	919.3	1.9	0.2	4.7	0.2	4.0	0.1	189
2,737	7,484	3,629	2,531.6	6.9	0.7	18.9	0.7	9.2	0.3	190
2,208	5,559	6,864	7,342.4	16.2	1.7	40.8	1.4	49.7	1.5	191
3,841	10,589	4,319	7,335.6	28.2	3.0	77.7	2.8	31.7	0.9	192
...	...	...	...	24.1	2.5	58.8	2.1	70.5	2.1	

ocessing industries—see footnote[b]

TILE





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BLS Sector No.	Purchasing sectors	Column A: Direct distribution of supply of—Pulp mills: Million dollars	Pulp mills: Per cent of total	Paper and board mills: Million dollars	Paper and board mills: Per cent of total	Converted products mfrs.: Million dollars	Converted products mfrs.: Per cent of total	Column B: Each million dollars of output of processing industries required the following direct purchases from—Pulp mills, dollars	Paper and board mills, dollars	Converted products mfrs., dollars
	Total supply distributed	1208.9	100.0	3214.6	100.0	3415.4	100.0			
	Gross domestic output	945.0	...	2823.3	...	3404.0				
	Competitive imports	263.9	...	373.3	...	2.7				
	Inventory depletions	...	...	18.0	...	68.7				

Explanatory Notes:

Columns A and B refer to the distribution of total supply which equals domestic output (production) *plus* competitive imports *plus* inventory depletion.
Columns C and E refer to the distribution of domestic production *only* to Final Demand rather than total supply as columns A and B.
Column D refers to the net amounts of domestic production of the processing industries which went directly to final demand. Final demand is made up of the total of output going directly to exports, Federal Government, state and local government, gross capital formation, inventory additions, maintenance and construction, new construction, small arms and small arms ammunition *less* competitive imports and inventory depletions.
Small arms and small arms ammunition were included in final demand rather than as processing industries for purposes of mobilization studies when this analysis was instituted as a joint project by the Bureau of Labor Statistics, the National Security Resources Board, and the Department of Air Force.

paper and board manufacturers. However, the final demand for apparel causes the chain reaction previously described, whereby wholesalers, retailers, textile mills, rayon plants, manufacturers of such items as buttons, zippers, clothing ornaments, as well as the basic processors of wood, cotton, and other natural fibers, each in turn purchase for their own needs varying quantities of paper and board or products, principally for packaging purposes.

The above comparative tabulation shows considerable dissimilarity of pattern between direct purchases and the effects of final demand upon the production of pulp, paper and board, and products manufacturers. In the case of synthetic fibers (no. 52) for example, a direct purchase of $85 million of wood pulp is indicated, yet there is practically no final demand for synthetic fibers as such and therefore no measurable final demand for wood pulp in this instance. Instead, synthetic fibers (composed largely of wood pulp), are processed into textiles which in turn end up in apparel as a final demand product. As a consequence, we see why the final demand for apparel has such an important effect upon wood pulp, first for synthetic fibers and then for the use of pulp in paper and board for packaging items.

A BASIS FOR PROJECTING FUTURE MARKETS

The heart of a marketing analysis is often its relation to future developments. The carrying through of a complete analysis projected into the future is a very difficult but not insuperable task.

The *first* step is an attempt to judge for a future period under consideration the probable aggregate level of economic activity. This will usually take the form of an estimate of the size of the gross national product under the expected conditions. Such factors as productivity and population growth will usually be considered, and some judgment will be required as to whether boom inflation, recession, or other conditions are to be expected.

Second, with some notion as to the aggregate level at which the economy is expected to operate, one may estimate what purchasing power will be exercised by the principal spender groups. Such estimates will depend on whether one expects exports to rise or fall, Government expenditures for munitions or for foreign aid to increase or decline, whether consumer savings are likely to be relatively more or less important, whether a high level of equipment expenditures will continue, and so on. Experience, assisted by observation of current economic trends, government policies, international developments, and the like should be used as a guide.

The *third* step will be to judge the direction in which the important spender groups will exercise their purchasing power. This will require estimates of the expected change in importance for the consumer expenditure pattern of such things as passenger cars, television sets, new homes, house furnishings, food, clothing, and so on. An appraisal of the areas in which capital formation may be expected would be required. In the present world situation, a careful appraisal of the probable kind and amount of government expenditures may be especially important.

The result of all the above steps will, in effect, be a hypothetical duplication for some future period of the entries shown in column D, final demand. In all the above, the input-output statistics themselves give no direct assistance except insofar as they provide a record of past behavior as a platform from which to launch projections. The whole process is essentially forecasting, which is likely to remain an art rather than a science, and for which there can hardly be any fixed rules.

Having formulated an estimate of the demand schedule to be imposed on the processing system, there remains to be considered the structure of that system itself. The input relationships for a base year, such as those implied in the 1947 input-output data, are not immutable; they change constantly, although in the aggregate rather slowly. There is no need to indicate the processes by which adjustments for change to input structures might be made. It will simply be pointed out that where changes in materials use, whether caused by technological shifts, price substitutions, or for other reasons, are relatively important, they are likely to be known; and if they are known some adjustment for them can be made. In any case, the *fourth* step should be a careful consideration of whether important structural changes have occurred, and the type and extent of any adjustments required to account for them.

The *fifth* step will join the estimated demand and processing structures to determine the consequences of the estimates on the pulp, paper and board and products industries. It is in this and the preceding step that the interindustry relations approach makes its direct contribution. For example, after having made necessary practical adjustments in the 1947 basic data and estimating percentage changes in the final demand for each category, a purely mathematical pro-

Processing Industries and to Final Demand, 1947 (*Continued*)

Column C: Each million dollars of final demand deliveries by processing industries required (directly and indirectly) domestic production of—			Column D, direct deliveries of domestic production of processing industries to final demand,[b] million dollars	Column E: Final demand[b] deliveries by processing industries required (directly and indirectly) domestic production of—						
				Pulp mills		Paper and board mills		Converted products mfrs.		
Pulp mills, dollars	Paper and board mills dollars	Converted products mfrs., dollars		Million dollars	Per cent of total	Million dollars	Per cent of total	Million dollars	Per cent of total	BLS Sector No.
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	945.0	100.0	2,823.3	100.0	3404.0	100.0	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...

[a] Less than 0.1%.

[b] Final demand entries in parentheses are negative amounts. For these industries the total of competitive imports and inventory depletions was greater than domestic output delivered to other segments of final demand (exports, Government, household, etc.). These amounts might be considered as additional demand U. S. pulp, paper and board and converted product production if U. S. production in these industries were to supplant such imports or inventories were not utilized. This is also true in other industries to the extent they have competitive imports.

[c] The total of the amounts of the "all others" sectors in column A, i.e., those amounts going directly to final demand from pulp mills, paper and board mills and converted product manufacturers are reflected in the entries for these industries in column E on lines 44, 45, and 46, respectively. For pulp mills and paper and board mills, these are negative entries since imports and inventory depletion totalled more than the aggregate of the other segments of final demand.

dure may be followed. This is accomplished by raising or lowering the total direct and indirect requirement for pulp, paper and board, and converted products for each sector by the same degree as the final demand for each sector is estimated to have changed. The total of these requirements would be the over-all demand for domestic production of pulp, paper and board, and converted products.

A *sixth* and final step may be an interpretation of the results of the last stage in terms of the probable consequences for a single film. The circumstances of the firm itself will largely determine how this is to be done and no generalizations about it can be made.

While the complexities of the kind of structural analysis portrayed above are difficult, they can be overcome. It seems a virtue, rather than a limitation of the approach, that a careful consideration of such problems of demand and processing structure as those raised above is required, and that the results of deliberate judgment on them can be specifically and quantitatively incorporated within the framework of the analysis.

Other methods which do not require such detailed consideration of demand and processing structure also typically cannot accommodate or make use of even well-established data or judgments regarding them.

The procedure outlined above may be time-consuming and expensive. Hence, it is not an approach to be applied to simple or unimportant questions but should be reserved for situations in which the critical nature of the decision to be made justifies the use of the detailed deliberations required in this type of analysis. These new and complex analytical techniques provide useful and consistent answers to many problems for which previously there was no suitable method of attack.

THE 200 SECTOR TABLES

The foregoing over-all analysis and observations apply in particular to the composite 200 sector statistical tabulations, prepared by the Bureau of Labor Statistics, as follows:

Interindustry Flow of Goods and Services by Industry of Origin and Destination
Direct Purchases per Million Dollars of Output
Direct and Indirect Requirements per Million Dollars of Final Demand
General Explanations of the 200 Tables:
The 1947 Interindustry Relations Study
BLS Report No. 33, June, 1953

Anyone interested in obtaining these complete data for more intensive analysis may obtain them from the Bureau of Labor Statistics, Department of Labor, Washington 25, D. C.

EXAMPLES OF OTHER STUDIES

An example of the use of the input-output data in regional market analysis appears in Federal Reserve Bank of St. Louis "Monthly Review," for June, 1952. It presents the first application of the interindustry flow analysis to the economy of the Eighth Federal Reserve District. This analysis is an extension of the eighth district income studies and provides additional data on economic transactions between regional areas.

A special study on the applications of input-output data to the steel industry appears in the Federal Reserve Bank of Cleveland "Monthly Business Review" of October, 1953.

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REPORTS AND DISCUSSIONS

Presented at the National and Regional Conferences

Condensations of Annual Meeting Papers

THE following are condensations of a number of papers presented at the 39th Annual Meeting of the Technical Association (Feb. 15–18, 1954). The papers will be published in full in subsequent issues of *Tappi*.

Fiberglas as a Papermaking Material, THOMAS S. CHAMBERS

The elements of sheetmaking with fibrous glass are presented, with emphasis on solutions for the problems in this field most commonly reported by paper technologists. These include knowledge of the types and properties of fibers, methods for stock preparation, bonding techniques, and utility of the product.

Blown and drawn Fiberglas are described. Nominal diameters range from 0.5 to 9 mu. Fiber tensile strength is about 0.12 gram per sq. mu. Fiber length varies from less than 0.1 mm. to several millimeters. Fiber surface area may be as much as 30,000 sq. cm. per gram. These properties are comparable to those for many cellulose fibers.

Preparation of papermaking stock from blown Fiberglas is best carried out by very light beating at consistency not over 0.5% and at pH 3. Low pH is essential in obtaining good sheet formation. Chopped strands of drawn Fiberglas disperse best if coated with a water-soluble size, cut to $^1/_4$ in. length, added directly to suspensions of blown Fiberglas or cellulose pulp, and circulated in a beater with the roll lifted. Avoidance of mechanical damage is important at all stages in mill operation. Tensile and tear strengths improve on addition of limited amounts of chopped Fiberglas strand to blown fiber sheets and to beaten cellulose. A large number of nonfibrous binders serve as bonding agents; notable among them are polyvinyl acetate, butadiene copolymers and phenolics (especially in combination), polyacrylates, and silicones.

Papers containing a major proportion of Fiberglas may be expected to show superior thermal stability, shelf life, dimensional stability, chemical inertness, and filtration efficiency, among other properties. There are indications that cellulose pulps show superior tear strength as beating progresses if reinforced with chopped Fiberglas strand after beating. The ability of Fiberglas to increase the drainage characteristics of cellulose pulps and to dry rapidly may be helpful in mill operation. Papers for electrical use, plastic impregnation, and high efficiency filtration are now in production or expected to make their debut at an early date.

The History of Carbon Brick Linings in Alkaline Pulp Digesters, BEAUMONT THOMAS

This report presents the history and service record of 100 carbon brick linings which have been installed in alkaline pulp digesters in North America during the last 23 years. Both successful and unsatisfactory linings are reported.

The linings vary in thickness from $2^1/_2$ to 5 in. Thin linings have not been as successful as the thicker ones, but have usually been quite satisfactory where favorable conditions have been obtained and where there has been no compromise on design requirements to satisfy the demands for digester capacity. Most of the linings have been installed in old and badly corroded digester shells which were not originally intended to accomodate linings.

There have been some failures, but the successful linings greatly outnumber the unsatisfactory ones, and it is only after 20 years of trial that it has become possible to correlate facts with theory. Experience has taught what limits must be maintained on lining thicknesses and on control of materials. Greater success in the future will depend largely upon the ability to refuse to compromise the specified lining thicknesses and lining designs in the face of demands for digester capacity.

Carbon brick quality has been generally improved since the first linings were installed, and a variety of grades and types have been developed. Having close control of carbon brick quality, the aim in carbon brick lining design and installation is to achieve the maximum possible life obtainable with available joint materials. This has already been proved to be practical by the fact that service life periods of 12 to 17 years have already been obtained. If better mortar joint materials become available, it would be expected that results may be even more dependable.

A Laboratory Approach to the Study of Digester Corrosion, JOHN W. HASSLER

The corrosion experiments were conducted in glassware and in laboratory steel digesters. Weight losses of firebox steel immersed in cooking liquors provide the basic data which are supplemented by electrochemical measurements.

Results are not always reproducible. Some experiments had to be repeated scores of times in order to have a statistical basis on which to form conclusions.

Some conditions make the surface of steel more resistant to corrosion in alkaline liquors containing sulphidity. Such a surface state is called inert* as distinguished from a more active surface that corrodes readily.

Corrosive attack is minimized by establishing an inert surface on steel and then providing conditions that keep it inert. Unfortunately an inert surface is very easily converted to an active form. Thus, traces of nascent hydrogen released in the corrosion reaction can catalyze this conversion.

Polysulphides are one of the most dependable agents for stabilizing a surface. Corrosion is negligible when polysulphides constitute the major portion of the sulphidity. Small concentrations are less effective and in some cases can even be detrimental.

Straight kraft liquors are very corrosive but this corrosion is greatly reduced when wood chips are present. Several factors contribute to the reduced corrosion: (1) the reaction with wood depletes the concentration of active chemicals, (2) when direct steam heat is used, the condensate dilutes the chemical concentration, and (3) black liquor constituents aid in stabilizing an inert steel surface.

If full advantage can be taken of these factors, and if the laboratory digester surface is in an inert state at the start of a cook, then the corrosion is usually less than 15 i.p.y. However, even though every *known* precaution is taken, occasional cooks will show an i.p.y. from 50 to 100.

* Passive would be a more descriptive term but inert is used here because of a definite relation to liquors containing sulphidity.

Weight Profile Measurement of Paper and Machine Clothing with the Tracerlab Beta Ray Scanner, JAMES D. SADTLER and H. BOROFSKY

If fiber weight distribution across the sheet in paper from machines can be measured rapidly enough to allow the knowledge of weight distribution to be used as an aid in leveling out the sheet, important benefits will result. A Tracerlab beta ray scanner has been used in recent research at Southland Paper Mills, Inc. to accomplish such measurement.

The scanner operates on the principle that a sheet of material moving between a source of beta radiation and a radiation detector will absorb an amount of radiation proportional to the weight per unit area of the sheet. An electronic recorder is used to translate results into graphic form.

Results on paper have been excellent. Weight profile measurements, available in a short period of time, have enabled necessary machine adjustments to be made. Collected data facilitated the proper choice of a new headbox. Since the scanner was put into use, paper qualities and machine efficiencies have improved generally. These measurements have also enabled the technical service department to have an independent check of operations performed by machine crews.

The scanner has also been used to establish wear patterns for machine clothing. Analysis of profiles for wet felts removed from the machines has indicated corrective actions which should be taken to minimize felt wear and to assure uniform moisture distribution across the sheets. In this application particularly, use of the scanner has resulted in the saving of much time, since data which formerly took several weeks to obtain are now made available immediately.

The latest application of the scanner is in the analysis of wear in fourdrinier wires, in order to determine any possible influences of imperfections or wear in the wire upon improper sheet formation.

In conclusion, the beta ray scanner gives hope for more highly

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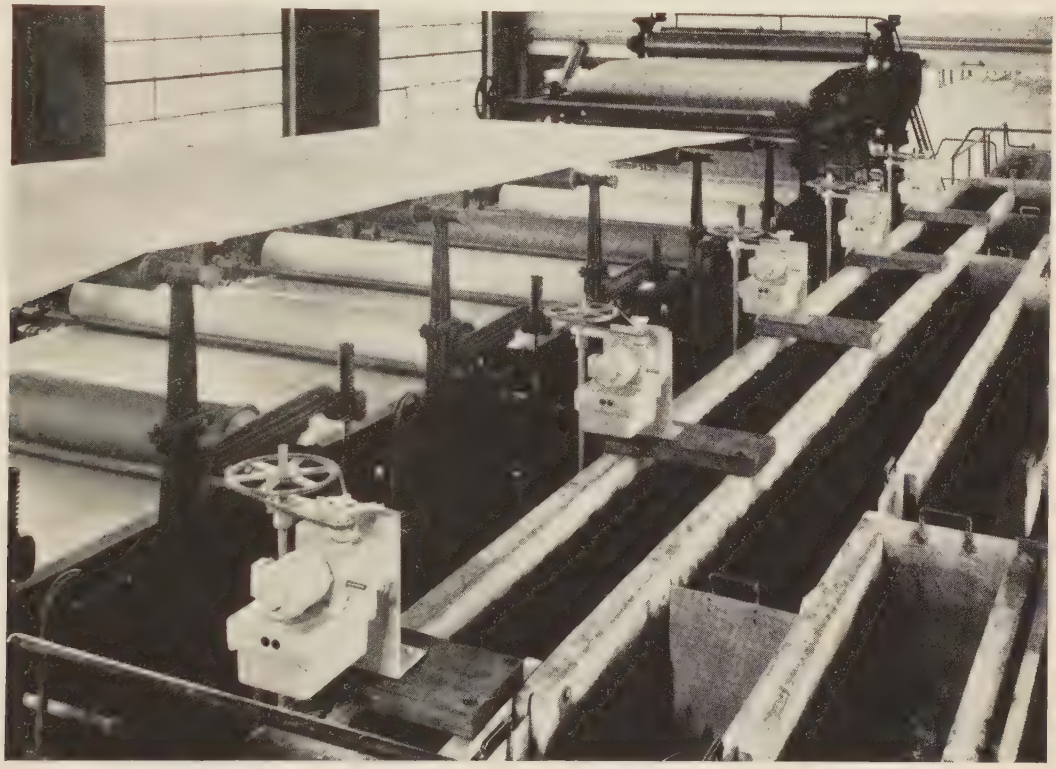

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technical and advanced control procedure for reaching and maintaining sheet quality. It will enable papermakers to obtain improved clothing life on the machines, improve their machine efficiencies, and give an improved economic position.

Beta-Gage Basis Weight Control, Fred W. Rauskolb

A description is given of a beta-gage system capable of presenting the necessary data for optimum basis weight control on the paper machine. Studies of basis weight fluctuation on the machine have led to the following conclusions:

1. Basis-weight variations in the machine direction are greater than was generally supposed.
2. Sheet profile (in terms of basis weight) is less stable and more subject to short-term changes than was shown by profile studies made on reel-end samples.
3. Because of these variations in the basis-weight profile, significant basis-weight data cannot be expected from a single beta gage head reading only one path down the sheet.
4. For best results, successive basis-weight profiles, taken over the full web width, are necessary for accurate and effective basis weight control.

Load Meters, Tension Meters, and Torque Meters For Paper Machines, John C. Harper, Jr. and T. A. McArn

In order to produce paper and board to meet the specifications and requirements of the consumer, it is important that machine variables be closely controlled. Satisfactory instruments for the control of wet-end variables have not been available, with the possible exception of stock preparation controls. The concept and development of the load meter provide a simple, accurate, and rugged method for measuring, recording, and controlling press roll loading, or other load points where uniform loading is important. The load meter employs the established principle of the Wheatstone bridge circuit to detect minute variations in the stress on a steel column. A slight change in load on the column results in a proportional change in flow of a small electric current. This current is in turn employed, by means of suitable instruments, to indicate, record, or control the applied load on the press. The load-sensitive unit is hermetically sealed and contains no moving parts.

Variations of the load meter system have been employed in similar arrangements to measure felt tension, refiner thrust loads, and fourdrinier wire tension.

An Experimental Study of the Factors Involved in the Manufacture of Paper Yarn, Geoffrey Broughton and James P. Wang.

Some of the factors such as twist, traveler weight, feed roller design, moisture pickup, surface-active agents, etc., involved in the manufacture of paper yarn were investigated on an experimental twister adapted from a standard cotton twister.

Breaking strength of the paper yarn produced was found to be linear with moisture pickup at any given twist per inch, independent of the surface-active agent used. The anionic type of surface-active agent appeared to be the most effective in causing maximum moisture pickup in the short time available during twisting. Concentration of surface-active agent was unimportant provided minimum surface tension was reached.

The Mechanical Properties of Paper—Part III, Geoffrey Broughton and James P. Wang

Handsheets were made by a carefully standardized technique from one lot of Douglas-fir bleached sulphate pulp. These were dried normally, by freeze drying or after water displacement by an organic solvent or by an aqueous solution of surface-active agent. At least 10 handsheets were made in any one series and broken or submitted to cycling on the Instron tensile testing machine.

Reduction of the surface tension during drying either by a surfactant or freeze drying resulted in large drops of sheet strength as found earlier by other investigators. The presence of nonpolar liquids during drying also greatly reduced sheet strength. An interesting observation was made that such sheets when exposed to high relative humidity (85%) over long periods of time increased in strength to about the value obtained for a water-formed and normally dried sheet.

The results are discussed from the standpoint of hydrogen bonding between cellulose fibers.

Evaluation of the TAPPI-SFMC Drainage Time Tester for Mill Control of Insulating Board Pulps, W. H. Graham

An examination was made of the functioning of the TAPPI-SFMC Drainage Time Tester of TAPPI Suggested Method T 1002 sm-51 in the control of pulps in an insulating board mill.

The drainage time tester is considered from the standpoint of its accuracy of results, reproducibility of results, speed and simplicity of operation, its ability to show differentiation of pulps, and its ruggedness.

A short statistical analysis is presented discussing the average and variations of drainage time obtained by four mill control men sampling the same pulp. The data are presented in the form of charts. The report also gives the design of a graphic aid which may be used to convert drainage time results to a standard dry pad weight basis.

A Comparison of the TAPPI-SFMC Drainage Time Test Procedure with Other Methods, D. R. P. Haig

Designed specifically for the testing of insulating board pulps, the TAPPI-SFMC Drainage Time Tester understandably has advantages over other test methods which are essentially modified papermaking procedures. In terms of free-draining or "fast" pulps, the modified papermaking procedures lack adequate sensitivity and, in at least one instance, resort to modifications of uncertain value in order to encompass that range.

Comparing the T-1002 tester with a "modified Green," it is pointed out that several important assumptions necessary in the use of the latter (which is of the "overflow" measurement type illustrated by the Schopper-Riegler, Canadian Standard, and the like) become observed behavior in the case of the T-1002 because of the transparency of the tester body. Uniformity of pulp suspension, swirling, and flocculation or creaming, all serious factors in relation to a true drainage index, are easily checked by observation throughout the test.

In comparison with the procedure set forth in T 221 m-50, "Drainage Time and Drainage Factor of Pulp," the T-1002 offers a more rapid, less complex method for the determination of the drainage characteristics of "free" pulps. In contrast with the after-test calculations required with the T 221 m-50 in order to arrive at a drainage factor for a given pulp, the T-1002 procedure permits the direct determination of a drainage time. The disadvantages noted in the opacity of the tester body of the modified Green apply similarly to the British sheet machine used in T 221 m-50 as well as an additional point in the inaccuracy of the end-point determination when applied to thick pads. A change in test stock consistency, set forth as a modification in the T 221 m-50 procedure to handle very free pulps, is a questionable variable that is eliminated in the T-1002 method.

Potential variables which might affect drainage time results using the TAPPI-SFMC tester have been investigated, and the plotted test data indicate that factors such as pad weight, stock pH, and stock temperature, although varying from free to slow pulps, all have discernible trends which permit compensation.

The Resistance of Douglas-Fir to Sulphite Pulping, Willliam H. Hoge

The precipitate which is formed in calcium-base sulphite cook of Douglas-fir was found to be primarily anhydrous calcium sulphate, with small amounts of free sulphur. The sulphate and the free sulphur were products of bisulphite decomposition.

The decomposition of sulphite cooking liquors was studied after developing suitable analytical procedures for determining the decomposition products. Dihydroquercetin, a phenolic compound in Douglas-fir, was isolated and a chromatographic procedure for studying phenolic compounds was developed. Dihydroquercetin reacted with bisulphite to form quercetin and thiosulphate. The thiosulphate promoted bisulphite decomposition in an autocatalytic, first-order reaction. Formic acid, free sulphur, and free sugars also promoted bisulphite decomposition through their reactions with bisulphite to form thiosulphate catalyst. Phloroglucinol, resorcinol, and catechin had no effect on the liquor.

Dihydroquercetin, in the presence of wood, failed to promote excessive liquor decomposition. The thiosulphate, formed in the early portion of the cook through the reaction between bisulphite and dihydroquercetin, was partially removed from the liquor by the wood or its reaction products, and was rendered unavailable for catalyzing bisulphite decomposition.

Dihydroquercetin was found to be a mild pulping inhibitor but there was no evidence of the formation of an insoluble lignin-inhibitor complex in cooks of Douglas-fir or of spruce impregnated with this compound. Sulphite studies showed that Douglas-fir lignin was sulphonated in a conventional sulphite cook. The pulps obtained from woods containing dihydroquercetin had a yellow color from quercetin. Quercetin was found to be a mild pulping inhibitor and the presence of quercetin in pulp increased the permanganate number.

The difficulty in the sulphite pulping of Douglas-fir is attributed to the slow rate of lignin removal which allows the bisulphite decomposition reactions to form large amounts of sulphuric acid before delignification is completed. The sulphuric acid precipitates the base as calcium sulphate and introduces the dangers which accompany the removal of the base.

The major advantage of soluble-base liquors is the extended availability of the base for the pulping reaction. With constant cooking times, the type of base in the cooking liquor had little effect on the lignin content of the resulting Douglas-fir pulps.

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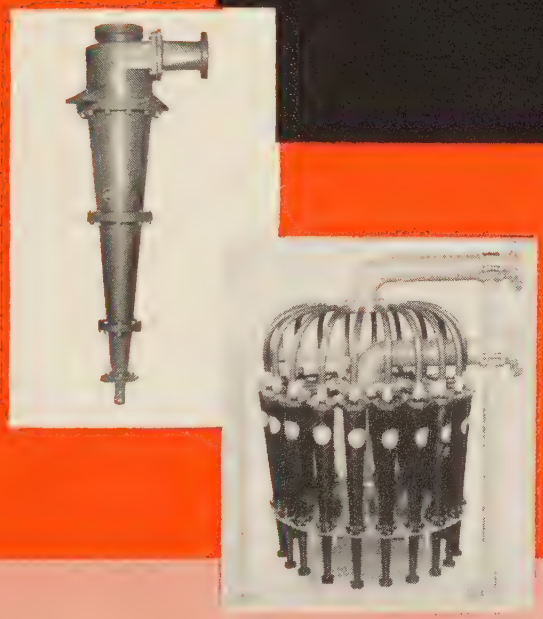

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The Use of Bases Other than Calcium in the Sulphite Process, R. S. Hatch

There is increasing interest in the use of bases other than calcium in the sulphite process both from the point of view of chemical and heat recovery and the abatement of stream pollution which is becoming of increasing importance particularly in this country. This discussion will be confined to chemical and heat recovery and no particular emphasis will be put on manufacture of lignin or carbohydrate derivatives.

The relative cost of the various bases will be considered and methods that have been proposed for chemical recovery will be discussed for the three bases; namely, sodium, ammonium, and magnesium.

Acid Sulphite Pulping Hardwoods as Well as Highly Resinous Softwoods, G. H. McGregor

The subject of acid sulphite pulping of certain deciduous or hardwoods, as well as highly resinous coniferous or softwoods has received attention from research groups for a considerable period of years. In this discussion we refer primarily to preparation of normally bleachable pulps.

Variation in forest resource species of a given area, coupled with the inability to move large-scale expensive manufacturing facilities, dictates the necessity for utilization of the various species in that area.

Those hardwoods receiving special attention in the past few years include aspen, birch, beech, cottonwood, chestnut, and gum. A limited amount of attention is given to the oaks, maples, and elms. Of particular interest, of course, is the pulping of aspen, birch, and beech.

In general, the common hardwood species mentioned can be satisfactorily pulped by the acid sulphite pulping process resulting in normal yield, bleachable pulps. It is recognized, of course, that the characteristic short fiber of the deciduous species somewhat limits the extent and type of papers into which it is converted. An exception to this group is chestnut which contains a catechin type tannin which inhibits acid sulphite pulping. It is recognized that a certain degree of trouble is experienced from aspen sulphite due to the presence of a characteristic pitchlike substance and inner bark fibrous specks. The latter is eliminated in the bleaching process. It is well recognized that problems relating to utilization of birch revolve around efficient removal of bark in woodroom operations. The acid sulphite pulping of gums, oaks, maples, and elms results in normal yield of unbleached pulps of characteristic darker color than aspen or birch. Aspen, birch, beech, and cottonwood may be readily bleached to acceptable brightness by normal three-stage bleaching procedure. Difficulties due to inherent coloring matter are experienced in bleaching gums, oaks, and maples to acceptable brightness.

The acid sulphite pulping of highly resinous woods has been the subject of rather exhaustive research on the part of prominent investigators such as Hägglund, Schwalbe, and Erdtman. As a result of their researches it has been quite definitely established that a certain fraction of the resins in certain species may serve as connecting links between large lignin molecules and inhibit acid sulphite digestion, particularly in the heartwood. Resins in pine woods do not necessarily inhibit penetration of acid sulphite cooking liquor, or the sulphonation process. Researches have indicated that pine heartwood extracted with ether or benzene cannot be satisfactorily pulped in spite of removal of resin, on the other hand, if the ether or benzene extracted wood is further extracted with alcohol or acetone, a small additional amount of resin is removed and pulping may proceed normally. It has been determined that certain resinous woods such as jack pine contain small quantities of phenollike substance which definitely inhibits complete satisfactory acid sulphite pulping regardless of base used for acid manufacture.

Some species rich in certain tannins cannot be satisfactorily pulped by the acid sulphite pulping process, although all tannins do not inhibit acid sulphite pulping. Redwood is rich in tannin but can be easily acid sulphite pulped, even though the unbleached pulp is somewhat dark in color. Douglas-fir contains a flavanone which explains the difficulty in acid sulphite pulping of the heartwood. Larch contains a flavanone producing an antiacid sulphite pulping effect. Sitka spruce is a very highly resinous wood yet can be readily pulped by the acid sulphite process. Such woods, of course, present other operating and handling problems due to the excessive pitch content.

It thus appears that woods nondigestible by the acid sulphite pulping process will probably contain substances that easily condense with lignins in the acid condition to form insoluble products.

65% Yield Sulphite for Newsprint Furnish, L. R. Beath

Total sulphite pulp requirements of a 700-ton per day newsprint mill are now being produced at 65% yield. The wood used is a mixture of spruce and balsam in approximately equal parts. Chips are cooked with calcium-base acid in stationary digesters. The softened chips are blown from the digester, broken down to a coarse pulp in two Sprout-Waldron refiners, and processed in Curlators to complete the defibering. Rejects from the screening system are returned to the Curlators for reprocessing in closed circuit. Strength, drainage, and cleanliness properties of the high yield sulphite are equal to, or better than, those of the normal yield sulphite previously used. Newsprint quality has been unaffected by the change in sulphite apart from a slight increase in bulk. Wood consumption with the high yield system is 118 solid cu. ft. of wood per air-dry ton of no. 1 sulphite. The prior system, without refining equipment for screen rejects required 167 cu. ft. per ton. The sulphite system operated for the past 4 years, with one Curlator processing screen rejects, used 148 cu. ft. of wood per ton. The high yield system and its operation are described.

Sulphite Pulping as Related to Stream Problems in the Eastern United States, Vance P. Edwardes

The same general problem of waste sulphite liquor disposal is common to all mills in continental United States, differing only in degree.

The first attempts at solution were based on economic grounds but, because of limited markets and competition, the amount of liquor which can be so utilized is small.

Several other means of disposal have been tried such as lagooning, road binder, aeration, soil conditioner, and controlled production. The degree of success has been from poor to fair.

Burning of waste liquor is not a simple operation and requires a large investment. The cost, in the case of mills of 150 tons or less, is prohibitive. Burning also introduces the problem of air pollution from fly ash and sulphur dioxide.

The use of soluble bases involves the recovery of chemicals with attendant higher investment costs per unit of production. With no chemical recovery the use of a soluble base can be justified only because of better wood utilization or special pulp qualities desired.

Scaling difficulties are still encountered with soluble bases but to a lesser degree.

Few eastern mills are of such size that an economic solution of the problem is at all possible.

Eventually, sulphite mills will have to reduce the discharge of waste liquor into the streams to satisfy growing public pressure.

Abatement of Spent Sulphite Liquor Pollution in the Pacific Northwest, H. R. Amberg

There are at the present time a number of methods for reducing sulphite pollution in the Northwest which are probably unique to this section of the country. Of the ameliorating methods, the most important are: (1) distribution of waste in the receiving water by the use of underwater diffusion lines, (2) lagooning of spent liquor as a means of waste disposal by controlled dilution, and (3) the use of spent liquor on secondary roads during the drought period.

As simple as these methods may seem, there are, however, inherent problems associated with all three methods which limit their application to specific situations. Another method of pollution reduction coming into prominence in the Northwest, is evaporation and burning of spent sulphite liquor. At the present time there are two mills evaporating and burning ammonia base liquor, and one mill utilizing the magnesium oxide process. The recovery systems have been effective in reducing pollution by 95% or more.

All of the above methods have been effective in reducing sulphite pollution in the Northwest, but as yet there is no specific solution that will be applicable to the entire industry.

Sulphite Pulping as Related to Stream Problems in the Mid-West, N. L. Malcove

Review of the activities in the Mid-West, particularly by the Sulphite Pulp Manufacturers' Research League, in regards to uses and disposal of spent sulphite liquor. To date three mills evaporate and burn spent sulphite liquor, one mill produces yeast, and one more yeast plant is being constructed. All sulphite mills in Wisconsin are doing something to alleviate the stream by some means or other whether it be evaporation and burning, yeast, road binder, product development, ponding, or lagooning.

An Investigation of Methods for Dimensionally Stabilizing Paper, F. W. Lorey and C. E. Libby

It was found that basis weight had no effect on the expansion of handsheets with increases in humidity nor did fiber size, except when the fibers were very coarse and greater expansion occurred. Freeness also had no effect except at high freenesses where the pulp was bulky and expansion greater, but sheets subjected to high pressures showed less expansion. The application of heat to wet handsheets decreased the expansion of the dried sheets with increases in humidity, but beater addition of a clay filler had no effect. Dimensional changes of sheets formed from sulphite pulp increased as the purity of the pulp increased, and sheets made from hardwood pulps expanded to the same extent as sheets

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made from softwood pulps. Silicone and rosin sizes, added by beater addition, did not decrease the dimensional changes of handsheets with changes in humidity. Neoprene-treated handsheets showed decreases in expansion with increases in humidity as the addition of neoprene was increased above 20%. When thermosetting resins were applied by impregnation, the handsheets showed less expansion with increases in humidity, and of the resins investigated, phenolformaldehyde, thioureaformaldehyde, and glyoxalcellosize exhibited optimum effects in the order listed. Urea, a plasticizing agent, showed a negative effect and increased the dimensional changes with changes in humidity.

Consistency Regulation, David De Zurik

A survey is made, from the plant operator's viewpoint, of the factors to be considered in planning the installation of consistency regulating equipment at various stages of processing. Typical installations are illustrated, ranging from the initial stages of pulp production through the bleach plant and screening department into the stock preparation departments and up to the final point of control ahead of the paper machine.

Effects of Mechanical Preparation and pH on the Strength of Glass-Fiber Paper, M. J. O'Leary, R. B. Hobbs, J. K. Missimer, and J. J. Erving

Research during the past year at the National Bureau of Standards has shown that the tensile strength of paper made entirely of glass fibers can be increased to more than 300 p.s.i., as compared with tensile strengths of only 30 to 40 p.s.i., reported in an earlier article on this subject [*Tappi* 35: 289 (July, 1952)]. This result is due to control of the pH value and certain changes in mechanical handling of the fiber in the mill. Beating is conducted at a temperature of 85°F., and the pH is adjusted to 3.5 or less with sulphuric acid. The pH value of the fiber suspension is further regulated at the jordan and headbox to about 3.0. When the glass fibers are beaten under these conditions, the jordan can be used to break down strings or lumps of fibers. The paper can also be dried to a much lower moisture content before going onto the reel.

The effect of higher beater temperature in promoting dispersion of the glass fibers may be due to thermal expansion of the glass and to decreased viscosity and interfacial tension of the water, so that it wets and penetrates the fiber bundles more readily. The effect of pH, as indicated by photomicrographs, depends on the formation of a gelatinous silica-rich layer on the fibers, which serves to bind them together in the finished sheet, giving higher strength. The pH value must be below 4 to obtain this effect, and the tensile strength increases as the pH decreases in the range studied. Ionizable acid disappears during the formation of the sheet, and the pH value of the finished paper is nearly neutral.

Studies of Rosin Sizing by Means of Autoradiography and Electron Microscopy, Charles W. Hock

The light microscope is an extremely useful tool for both research and control in the pulp and paper industry. There are, however, instances where the light microscope gives only meager and insufficient information. Visual studies of rosin sizing are a case in point. In order to obtain new information about this old problem, thereby giving a better answer to "How and in what form is rosin size distributed on the surfaces of fibers in a sheet of sized paper?" the electron microscope, with its higher resolving power, was utilized.

Size precipitates, white water samples, and single fibers from sized sheets were examined. Direct electron microscopical examination of size precipitates and of white waters revealed that the particles of rosin size were more or less round, that they averaged about a thousand Angstroms in diameter, and that they occurred either singly or in groups. Because single pulp fibers are too thick to be used directly in the electron instrument, the examination of their surfaces was accomplished by means of surface replication, wherein impressions of single fibers in thin films of plastic are used as specimens.

The replication of objects as small as single wood pulp fibers is tedious. Fortunately, autoradiography (a technique of locating radioactive material by allowing a specimen to take its own picture) of single fibers from paper sized with radioactive rosin size showed that all the fibers were sized equally. This knowledge of fiber-to-fiber uniformity brought within practical limits the number of single fibers requiring replication. The electron micrographs revealed that the sized fibers had comparatively rough surfaces, owing to the fact that the fibers were irregularly covered with size particles similar to those seen previously in size precipitate and in white water. On the other hand, micrographs of fibers from unsized waterleaf sheets were smooth, except for the normal fibrillate surface pattern.

These observations support the often expressed opinion—hitherto not adequately confirmed by direct visual observation—that rosin size is not present as smooth surface-covering films but rather in the form of discrete particles.

Sizing of Paper Under Neutral or Alkaline Conditions, W. F. Reynolds, L. A. Lundberg, and J. C. Barthel

A new sizing agent, the salt of a hydrophobic polyfunctiona amine, has been developed to size neutral and alkaline papers, including calcium carbonate filled papers. It is a thermoplastic, water-dispersible, light brown colored synthetic wax. Dissolved in hot water it produces a cationic colloid of exceedingly smal particle size. Effectively retained by fibers to the extent of about 70%, the size is applicable to a wide variety of pulps ranging fron groundwood to ragstock. The size may also be applied at the size press or calenders to impart sizing or augment conventiona sizing.

Application variables involved in using the size are describec with a discussion of such factors as size-fiber contact time, stock temperature, effect of various anions and alkaline fibers, stock pH, presence of rosin size and alum, and drying conditions.

Among the outstanding properties imparted by the size to paper are high resistance to the penetration of writing ink and alkaline solutions, reduced tendency of the paper to curl when wetted on one side, improved resistance to color degradation on exposure to ultraviolet light, and improved resistance to buty carbitol penetration. The new size has been found useful in a wide variety of paper grades, such as noncorrosive wadding, napkins, coating raw stock, bags, hanging, board, label, and alkali-resistant papers.

A New Process for the Bleaching of Kraft Pulp with Sodium Peroxide, Willard F. Schroeder and John R. Seferian

The bleach response of sodium peroxide in the last bleaching stage has been improved considerably by means of an acid post-treatment to the preceding hypochlorite stage. In this post-treatment technique, the pulp at the completion of the hypochlorite stage is adjusted to a pH of 5 with a mineral acid at low density, washed after a short treatment time, and bleached with an alkaline peroxide solution in the last stage. With the proper use of this process, it has been found possible to produce bleached kraft pulps in the mid-80's with superior brightness stability and strength properties.

This new process is readily adaptable to most existing multi-stage bleacheries, which have used only hypochlorite and alkaline extraction treatments in the latter stages of the bleaching process.

Chromatographic Techniques in the Analysis of Pulps, Jerome F. Saeman, Wayne E. Moore, Raymond L. Mitchell, and Merrill A. Millett

Chromatographic analysis is being applied increasingly to the determination of the carbohydrate components of purified pulps and to the study of the effects of these components on cellulose derivatives.

Quantitative chromatographic techniques are generally sensitive, but suffer from being expensive in man-power requirements. In this paper, methods are described for reducing the cost of such work. The various steps, including hydrolysis, neutralization, evaporation, separation, elution, and final sugar determination, have all been studied to minimize time requirements and to determine the errors contributed by each step. The usefulness and present limitations of the technique are described.

A comparison has been made between the pentosan content of pulps determined by the Technical Association of the Pulp and Paper Industry's method and the values obtained by chromatographic analysis. At high pentosan content, agreement is satisfactory. At low pentosan content, the TAPPI method is shown to have high inherent errors due to the fact that the residual unhydrolyzed cellulose contains relatively large amounts of pentosan. The error due to this cause can be eliminated by total hydrolysis of the pulp, followed by an appropriate pentose analysis.

A Comparison of Processes for Generating Chlorine Dioxide in Pulp Mills, W. Howard Rapson

The author has studied the operation of twelve chlorine dioxide plants, including at least one of each of the six processes now being offered for generating chlorine dioxide in pulp mills. Three of these processes are in operation in Europe, known by the names of their inventors, Holst, Persson, and Kesting. The three originating on this continent, known by the companies developing them, are C.I.P., Mathieson, and Solvay, in order of development.

All six processes operate well and are producing chlorine dioxide of sufficient quantity and quality to satisfy the requirements of pulp bleach plants. Major differences among them are found in capital cost, raw material requirements, maintenance difficulties, ease of start-up, shutdown, and change of production rate, simplicity of control, and explosion hazards.

The Kesting process (Day-Fenn process in the United States) involves a high capital investment since it requires an electrolytic plant for manufacturing sodium chlorate coupled with the chlorine dioxide generator. The other processes begin with purchased sodium chlorate, and therefore have much lower capital invest-

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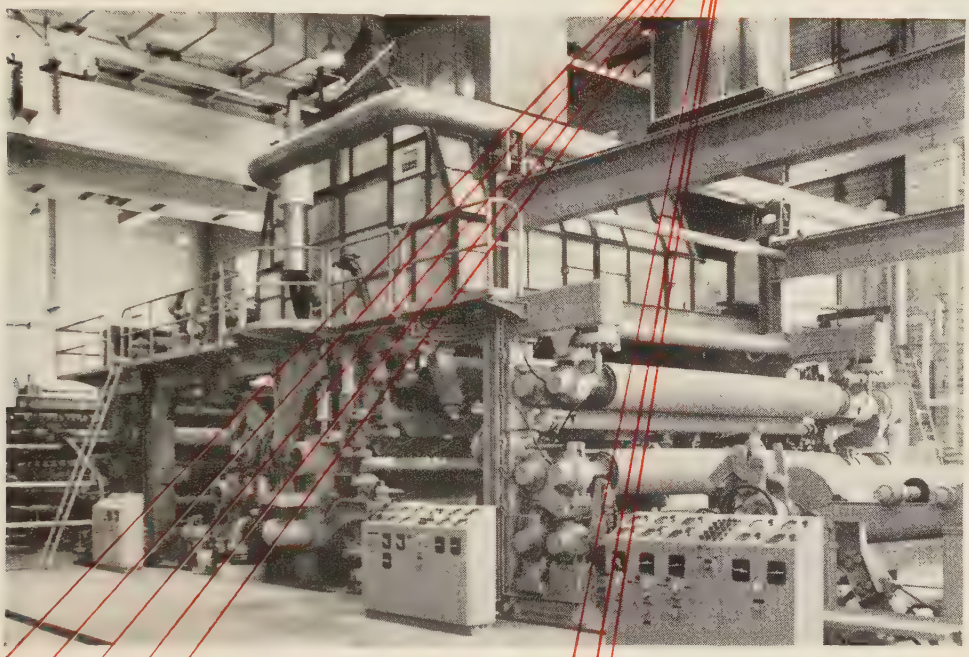

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ment. The Persson process involves two coupled continuous cyclic processes, one reducing chromic acid to chromic sulphate by sulphur dioxide, and the other reducing sodium chlorate with chromic acid to produce chlorine dioxide. After crystallizing out Glauber's salt, the liquor is recycled. Equipment requirements are therefore higher than in the other four processes. The Solvay process involves reduction of sodium chlorate by methanol in the presence of sulphuric acid, while the Holst, Mathieson, and C.I.P. processes depend on reduction of sodium chlorate by sulphur dioxide with the addition of sulphuric acid in the first two, and without the purchase of sulphuric acid in the last one. Equipment costs in the last four processes probably differ by less than 20% if adequate storage facilities and instrumentation are provided in each case.

A comparison is made of chemical reactions, equipment requirements, materials of construction, operating problems, material balance, and relative cost of chlorine dioxide for the various processes.

Some Examples of Designed Experiments in Industry, Charles A. Bicking

This paper is written from the point of view that in most of its industrial uses statistics is an experimental tool. An outline is given of experimental procedure when it involves statistical design of experiment. Paper industry applications are described which emphasize the experimental aspects of accumulating data in industry whether process control, laboratory analysis, or research and development problems are involved.

Five examples cover the design of control charts for process control: the use of significance tests to determine whether the two gages of a Mullen tester read the same; an experiment to determine whether four thermometers read alike; an experiment to determine whether analysts or the thermometers themselves are the cause of variability; and a complex experiment to determine the effect of varying four processing factors on photovolt brightness after a multistage bleach.

Some of the new methods of designing experiments suitable to the particular requirements of industry are mentioned. It is pointed out that the preplanning of experiments is not only necessary but in recent years has become popular.

The paper is illustrated with a typical control chart. Also, an appendix contains original data, computations, and variance tables on which discussion of the examples is based.

Predicting the Brightness of Groundwood-Sulphite Pulp Mixtures, D. J. MacLaurin and F. A. Aflenzer

Spruce groundwood and sulphite pulps were each bleached to several brightness levels with sodium peroxide and calcium hypochlorite, respectively. The brightnesses of an array of mixtures of these two series were measured and calculated. The measured and calculated values were in very good agreement. Thus it appears that the brightness of any multipulp mixture can be predicted by calculation when the brightnesses of the components are known. When unit bleaching costs of the components are known it is therefore possible to calculate the optimum brightness for each component to give a minimum over-all bleaching cost for a given brightness of a mixture.

Methods for Cellulose Accessibility Determination, Geoffrey Broughton, Robert E. Heeks, and Conrad Johannes

With the increasing importance of accessibility in pulp and paper technology it seems desirable for the Chemical Methods Committee of TAPPI to have available a suitable standard method for its determination. Accordingly the methods so far used for the measurement of accessibility have been reviewed. Physical methods include x-ray diffraction, infrared absorption, density, water sorption, heat of wetting, and deuterium exchange measurements. Among chemical methods should be mentioned those depending on acid hydrolysis, oxidation, and esterification. It is concluded that for rapid, routine estimation of cellulose accessibility water vapor sorption should receive first study as a basis for a possible TAPPI standard method for determination of accessibility.

Photometric Determination of the Solubility of Pulp in Sodium Hydroxide Solutions, Ralph M. Kingsbury

A photometric procedure for determining the solubility of pulps in sodium hydroxide solutions was found to be convenient, rapid, and at least equal in precision to the gravimetric procedure for determining beta-cellulose.

Comparison of results obtained by this method on a number of purified pulps indicates that the amount of alkali-soluble material and the relative proportion of the fraction that precipitates on acidifying the extract is dependent on the history of the pulps.

Identification of Wet-Strength Resins in Paper by a Dye Staining Technique, R. R. House and N. T. Woodberry

Because of the increased use of wet-strength resins in the paper industry during the past 10 years, it has become important to have a quick and accurate means of identification for these resin-treated papers. Several years ago a dye staining technique was developed, the use of which made it possible to identify most wet-strength papers. Recently, however, new types of urea resins have become commercially available and it was found necessary to modify the dye staining test to cover these resins.

The revised dye staining method given in this paper is not as simple or rapid as desired by the wastepaper industry, but it is a reasonably quick and easy test to perform in or out of the laboratory.

A blue acid dye is employed which is selectively adsorbed by the various resins (urea and melamine) and various protein materials (glue, casein, etc.) which may be found in wet-strength papers. By use of several pretreatments and dyeing procedures, it is possible to positively identify paper treated with a melamine resin. The test may also be used to identify some types of urea resins while supplementary tests may be necessary to help differentiate between other types of urea resins and protein materials.

Quality Control Rates Raw Material, W. A. MacCrehan

In today's competitive market, the converter cannot afford to be unconcerned for the level of quality of the raw materials flowing into his finishing operation. For every excessive variation entering the receiving door, a potential problem exists as a result in the finished converting operation.

Is there a magic solution to this variation? No, and emphatically, no! However, through planned statistical routines many costly variables can be isolated from usable material.

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3. Recognizing that papermaking is an "art" that is slowly becoming a "science" through the progress of measuring variation.
4. Sticking to basic problems, seeing these through instead of blanketing the pressroom problems and weakening the quality attack to the problems.

The control of raw material by graphic statistical methods can and will build finer products. Three points are vital—first, common sense in working out problems with your supplier; second, internal strength by your own management in being objective in their relations with vendors; and finally, selling the program thoroughly within your own plant before dealing with vendors. These factors, when used effectively, will provide a key for better conversion of paper products through better controlled raw materials.

Control Chart for Newsprint Web Breaks, S. Steinberg

Part. 1. Newsprint is supplied by six mills. A control chart for the fraction defective for each is plotted by weeks. A "defective" is defined as a roll that breaks one or more times. (Breaks caused by missed autopasters or mechanical failures are not counted. Rolls that are warehoused are treated separately.) Runs of less than 100 rolls per week are not plotted; the subtotals are brought forward until 100-roll counts are exceeded, then plotted. Three sigma limits are used for judging out-of-control points. The latter are reported as promptly as possible to the mills that they may look for assignable causes for the variations. Mills may be "in control" but still maintain an average level high enough to interfere with pressroom schedules and production. The critical level of defectives for our printing operations can be said to vary from between 3 to 4%, depending on the numbers of rolls involved, and the size and nature of the press run. Then, a mill "in control" at too high a level must make changes to lower that level.

Part 2. A simple illustration of the value of statistics in showing the existence of a correlation. It was calculated, for the same six mills, that the use of 100% supply by one mill would produce an average of about 2.85% waste (not including wrappers or damage beyond the pressroom); whereas, the use of 100% supply by the other five mills in their present proportions would produce an average of 3.74% waste.

An Orienting Study of the Effect of the Neutral Sulphite Semichemical Cook on the Hemicelluloses of Aspenwood, David C. Lea

Three neutral sulphite semichemical (NSSC) cooks were made of aspenwood chips. The pulp yields were approximately 75%. Holocelluloses were prepared from the original aspenwood and from an NSSC pulp. Hemicelluloses were extracted with 5% followed by 16% potassium hydroxide from the holocelluloses, the NSSC pulp, and the original aspenwood. Hemicelluloses were also recovered from the the spent liquors of the cooks. The hemicelluloses, holocelluloses, pulp, original aspenwood, and residues left after extraction were analyzed for ash, Klason lignin, "apparent lignin" not determinable by the Klason procedure as indicated by ultraviolet absorption data, pentosans, uronic an-

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hydride, and sugars present and amounts of each. The sugar analyses were made by chromatographic techniques. In addition, the intrinsic viscosities (in 10% potassium hydroxide) were determined for the hemicelluloses.

The experimental data indicate that under NSSC cooking conditions used in the study:

1. One third of the hemicelluloses are removed from the pulp during the cook.
2. One fourth of the hemicelluloses removed during the cook can be recovered from the spent liquor in a relatively undegraded form with respect to molecular size.
3. The hemicelluloses remaining in the pulp are not degraded but are apparently made more accessible to caustic extraction.
4. The hemicelluloses from the pulp or pulp holocelluloses have greater intrinsic viscosities than the corresponding ones from aspenwood or aspenwood holocelluloses but the chemical analyses are quite similar.
5. There were no free simple sugars, di-, or trisaccharides in the NSSC spent liquors.
6. Degradation products of the pentosans are probably responsible for much of the ultraviolet absorption at 280 mmu of the filtrates from the lignin determination of high-pentosan, low-lignin containing materials such as hemicelluloses.

Report of Subcommittee for Semichemical Equipment Survey, J. E. Sapp

A survey has been made of the equipment and operating procedures currently in use in mills producing semichemical pulp. Nineteen mills producing semichemical pulp for a wide variety of uses cooperated in the survey. The replies of these mills have been tabulated and are discussed briefly in this report, the tabulated data being listed in thirteen tables as follows: Table I, Semichemical pulping capacities, wood species, wood usage, and types of products; Table II, Barking; Table III, Chipping; Table IV, Chip screening; Table V, Cooking equipment; Table VI, Cooking and yield data; Table VII, First stage defibering; Table VIII, Second stage defibering; Table IX, Washing; Table X, Pulp screening and cleaning; Table XI, Bleaching; Table XII, Furnish data; Table XIII, Liquor manufacture and recovery.

Problems in the Evaluation of Caustic Absorbency of Pulp Sheets, Richard W. Swinehart and Albert T. Maasberg

In cellulose derivative manufacture, production of alkali cellulose by continuous dipping has developed the need for pulps having special properties. In a particular process, the dipping time of from 1 to 3 sec. is an important factor in necessitating pulps with special physical properties. The continuous alkali cellulose process is outlined and the various types of alkali cellulose that may be prepared are indicated. Some cotton linters and a few experimental wood pulp sheets meet the requirements of caustic absorbency.

Since the ultimate test of a pulp is its conversion to an acceptable derivative, the problem facing both user and supplier of chemical pulp is to gain a knowledge of the properties of the pulp sheet as they affect caustic absorbency, a means of evaluating these properties and their correlation in respect to the final properties of the derivative produced.

Uniformity of sheet formation is of greatest importance. A nonuniform sheet, when backlighted, shows contrasting light and dark areas and swells unevenly when dipped in caustic due to uneven penetration.

There is some indication that the density and porosity of a sheet are influenced primarily by hydration.

Mechanically pressing the sheet affects its caustic absorbency. Indications are that further study of the effect of pressing on porosity might make possible the evaluation of variables in fiber processing before sheeting.

While mechanical pressing changes the density and porosity, it does not change the water absorbency to any great extent. Indications are that an acceptable pulp will have a water absorbency of 400 to 600 sec., a basis weight of 41 to 46 grams per sq. ft., a density of 0.42 to 0.49 gram per cc., and a Gurley porosity of 8 to 20 sec. (three sheets per 300 cc. air).

In a 50% caustic absorbency test, acceptable cotton linters fall within a range of from 7 to 12 sec. while most wood pulps range from 10 to above 50 sec.

A bursting strength of 55 ± 10 p.s.i. and a moisture content of 5 to 7% are satisfactory.

A Cellulose Yield Test Overcoming the Inadequacies of the Alpha Test, Frank R. Charles

There is great need in the viscose industry for a laboratory test which will give an accurate prediction of the yield of rayon, cellophane, or other regenerated cellulose product obtainable from a dissolving pulp. The alpha-cellulose test fails to do this. A simple test is described, based on Porrvik's 1928 publications, wherein approximately 0.3 gram of sample is steeped in 21.5% NaOH and filtered, the insoluble and soluble portions being determined by dichromate oxidation (p and q ml., respectively) and the "rayon cellulose" percentage calculated simply as $100p/(p + q)$. Three possible sources of error are avoided as no accurate weighing of sample, no moisture test, and no absolute standardization of dichromate are required.

Data are given to show that the reproducibility of the "rayon cellulose" is of high order and definitely better than that of the alpha-cellulose.

Data are then given on 116 different types of dissolving pulp to show that the "rayon cellulose" is numerically equal to the viscose yield within a very small tolerance over the whole range of usable pulps, that is from 86.9 to 98.5 alpha-cellulose and from 3 to 10 intrinsic viscosity. The alpha-cellulose, on the contrary, shows enormous variations with viscosity and other factors. For instance, pulp of intrinsic viscosity 9.0 needs 6% higher alpha-cellulose than one of 3.0 to give the same viscose yield at the 93% level. Alpha-cellulose still shows wide variations even after correcting for viscosity.

The "rayon cellulose" test has been successfully used in routine mill control for the past 14 years in the dissolving pulp mills of the Canadian International Paper Co.

It is also shown that "cellulose resistant to 10% NaOH" varies with viscosity just as greatly as does alpha-cellulose so that the recent independent proposals of Bartunek and Wilson to link rayon *quality* (strength and fatigue in the case of Bartunek) with the difference between 10 and 18% solubility must fail unless an empirical correction for viscosity is applied to the 10% solubility, or the test carried out on aged alkali cellulose.

Viscose Filter Number Evaluation of Cellulose Pulps, E. L. Hanson and L. M. Cooke

Cotton linters and dissolving wood pulp samples can be characterized on the basis of viscose filter number. This property is definitely related to the source of the raw material as well as to the raw material processing conditions. The viscose filter number is a property which should be determined or reported on a new or modified pulp. Such data are not only useful from the standpoint of evaluating fundamental properties of a given pulp, but they are also of considerable importance to the pulp user. The latter is particularly true with cotton linters which generally have lower filter numbers than wood pulp.

The Visking method for determining the filterability of viscose solutions is described and discussed. The method employs a laboratory scale pressure filtration and determines the amount of viscose which will pass through a one square centimeter cotton wadding filter pad before the filter pad becomes completely plugged. The method is sensitive to the structure of the filter medium and consequently, filter number values must be identified as to specific lot or batch of filter medium. The Visking Corp. has calibrated various batches of filter media and several industrial laboratories are using such standardized filters so that significant and reliable filter number data can be exchanged.

The laboratory production of viscose for purposes of evaluating pulp filter numbers is described. Sources of error are discussed and micrographs of filter plugging material are shown.

An Investigation of Haze in Cellulose Acetates Made From Wood Pulps, Keith E. Bradway

A study was made of the "haze"—i.e., that substance which caused turbidity in acetone solutions—isolated from three cellulose acetates made from wood pulps and one from a linter acetate. Small amounts of haze could be removed by centrifugal means, even from commercially suitable acetates. The coarsest fraction always contained some fibers or fiber fragments; otherwise the hazes consisted of amorphous masses. The hazes from from commercial acetates had low acetyl contents, whereas those from two very hazy acetates had acetyl contents in the range of acetone solubility. Despite their acetyl content the hazes were insoluble except in formic acid. The haze from a very hazy acetate was richer in ash than the remainder of the acetate but contained predominantly polysaccharides. Hazes from wood pulp acetates always contained xylans and mannans with large amounts of cellulose. All the haze was removed by fractional precipitation from two cellulose acetates made from wood pulp. All of the mannans and xylans originally in the acetates were present in the total hazy fractions, and apparently were one cause of the haze. The hazy fraction from a very hazy acetate caused filtration difficulties, was higher in combined sulphate, uronic acids, and ash; and contained particles which caused thick spots in a film. This fraction was not solubilized by reacetylation, but was clarified if reacetylated after removal of mannan and xylan. Cellulose probably was present in the haze because it was shielded from reaction.

Effect of Medium in the Acetylation of Cellulose, R. C. Blume and F. H. Swezey

The acetylation of high-molecular weight cellulose without degradation has been carried out in pyridine-acetic anhydride systems. Hess and Ljubitsch [*Ber.* 61:1460 (1928)] found, how-

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ever, that even with most elaborate swelling pretreatment of the cellulose, several weeks were required for complete reaction. Cellulose also acetylates without degradation in the acetic anhydride-potassium acetate system. This reaction, too, is relatively slow. Twenty-four or more hours are required for production of cellulose triacetate.

It has now been found that purified high molecular weight cellulose can be acetylated rapidly and without degradation by the acetic anhydride-potassium acetate system using dialkylamides or gamma-lactones as the reaction medium. The new media give a 20 to 30-fold increase in reaction rate even when the celluloses used are given no special pretreatment. The effectiveness of the media in promoting the reaction correlates with the known dielectric constants which permits postulation of reaction mechanism. These media have also been applied effectively in the acid-catalyzed acetylation of cellulose with acetic anhydride.

Carbohydrates in Woods and Pulps by Chromatographic Analysis, Albert Z. Conner

It is a well-known fact that the hemicelluloses remaining in wood pulps after commercial pulping operations have a marked influence on pulp properties and quality. It is also true that very few satisfactory methods are available for determining the relative amounts of the various polysaccharides in cellulosic materials. In order to attempt a correlation of pulping process variables with pulp quality, a research method has been developed for determining the carbohydrate composition of woods and pulps. The method consists of hydrolyzing the sample to its constituent sugars, separating the sugars quantitatively by paper chromatography, and determining the amount of each sugar present by a colorimetric procedure employing anthrone reagent. From these data, the relative amount of each polysaccharide in the original pulp can be calculated. Mannans, arabans, xylans, and galactans can be detected and determined in the presence of relatively large amounts of glucosans. By this type of analysis the influence of variations in pulping processes, bleaching conditions, wood sources, etc., on the hemicellulose content of the pulp can be determined. An attempt at correlating the presence of various amounts of each hemicellulose with pulp properties and quality can then be made. Data obtained in the development of the method are presented, along with results obtained by applying the procedure to a number of holocellulose and high alpha-cellulose wood pulps. Further applications and limitations of the method are discussed.

Purified Hardwood Pulps for Chemical Conversion. II—Prehydrolysis-Sulphate Pulps from Sweetgum, F. A. Simmonds, R. M. Kingsbury and J. S. Martin

Sweetgum (*Liquidamber styraciflua*) was pulped by the prehydrolysis-sulphate process using water only for the prehydrolysis stage. Severity of prehydrolysis was varied by extending its duration at 170°C. over the range of 0 to 150 min. Each degree of prehydrolysis was followed by cooking with two to three different amounts of chemical. Unbleached pulps were purified by a sequence of chlorination, extraction with sodium hydroxide, and oxidation with sodium hypochlorite. Aliquots of each chlorinated pulp were extracted by hot and cold treatments, respectively, prior to treatment with the hypochlorite. Prehydrolyzed chips and all pulps were analyzed chemically and the disperse viscosity of all pulps was determined. Also, an easily bleached sulphate pulp was made for comparative purposes. The wood contained, in per cent, lignin, 21.7; pentosans, 20.1; alpha-cellulose, 46.8. In prehydrolysis, maximum amounts of materials removed were 32% of the total wood substance, 31% of the lignin, and 81% of the pentosans. Maximum removals in complete pulping were, in per cent, wood substance, 68.8; lignin, 99; and pentosans, 97. In purification, mild hot alkaline extraction did not change the proportion of pentosans but cold extraction with a 5% solution of sodium hydroxide removed from 20 to 50% of the pentosans present in the unbleached pulps. Destruction of alpha-cellulose by these two treatments was essentially the same, ranging up to about 4% of that of the wood. Disperse viscosity was quite sensitive to decrease by increasing amounts of cooking chemical. Thus, by suitable combinations of degree of prehydrolysis, amount of cooking chemical and alkaline extraction, pulps high in alpha-cellulose and varying considerably in disperse viscosity, although not all necessarily extremely low in pentosans, can be produced. A pulp was produced in quantity for conversion tests, the results of which are to be reported.

Cellulose Solvents for Viscosity Measurements. The Effect of Copper and Base Concentrations in Cuprammonium and Cupriethylenediamine Solutions, B. L. Browning, L. O. Sell, and W. Abel

Copper-base solutions covering the composition ranges of 10 to 35 grams per liter of copper and with 125 to 250 grams per liter of ammonia or 50 to 150 grams per liter of ethylenediamine were examined as solvents for cellulose. Cuprammonium solutions containing more than 30 grams per liter of copper or 200 grams per liter of ammonia were not stable enough for practical use. If the copper concentration exceeded 10 grams per liter sucrose was necessary to stabilize the solution, and decomposition at 23° then occurred only slowly. In qualitative tests, chemical cotton and a rayon pulp dissolved completely in all the cuprammonium solutions, but a high-polymer cotton and bleached semichemical pulp left some undissolved residues unless the solutions contained 25 to 30 grams per liter of copper. All cupriethylenediamine solutions in which the base copper molar ratio exceeded 3:1 failed to dissolve cellulose. Because the solubility of copper hydroxide in the base limits the ratio to values above about 2:1, cupriethylenediamine solutions are effective cellulose solvents over only a restricted range of compositions.

The effect of copper and base concentrations on the specific viscosity was determined for the celluloses used in the qualitative tests and a flax pulp. The specific viscosities were markedly decreased by increase in ammonia contents over the range of 98 to 176 grams per liter, and were affected only slightly by copper contents over the range of 14 to 28 grams per liter. The copper and ammonia concentrations required for satisfactory dissolving power do not appear to be at all critical, and the small residues noted in some qualitative tests did not significantly affect the viscosity.

The compositions of cupriethylenediamine solutions which dissolve cellulose satisfactorily are rather limited, and the TAPPI solvent 1 *M* in base and 0.5 *M* in copper was the best of the solvents tested. Solutions 0.75 and 1.00 *M* in copper were less satisfactory, and those 0.25 *M* in copper did not dissolve cellulose. The solubility of cellulose was reduced when the base-copper ratio was increased to 2.5:1, and solution was generally quite incomplete when the ratio was 3:1. The specific viscosity decreases markedly as the copper concentration is increased from 0.5 to 1.0 *M*, with the base-copper ratio of 2:1. Increase in the base-copper ratio generally increases the specific viscosity.

Tests on chemical cotton showed that the intrinsic viscosity is dependent upon the copper and base concentrations used in the solvent. However, no feasible concentrations of curprammonium and cupriethylenediamine solutions were found which would yield identical values for the specific viscosity in the two solvents.

Condensate Corrosion—Its Causes and Prevention, Selden K. Adkins and Maurice F. Nielsen

Paper mills, having relatively large and complex condensate systems, are vulnerable to troubles resulting from corrosion. Unscheduled outage, damage to driers, piping, and allied equipment often increase cost of operation and maintenance.

Dissolved gases and consequent low pH values, resulting from inadequate removal in the pretreatment system or chemical removal, are the main factors causing condensate corrosion. Carbon dioxide, oxygen, and ammonia are the main offenders in this respect.

Pretreatment of boiler feedwater, when equipment is properly selected and operated, can greatly reduce the amounts of these gases in the system. Several systems, both hot and cold, are available to accomplish this. Selection of the specific equipment necessary can be made only after all factors such as make-up requirements, raw water supplies available, type and pressure of boilers, and plant design have been included in the final evaluation.

Even when all of the mechanical methods available have been efficiently utilized to reduce the dissolved gas content of the system and consequently the intensity of the corrosion, additional chemical treatment is necessary to completely conquer the problem. Here, again, several methods and treatments are available. Make-up requirements and equipment involved must again be thoroughly considered before a choice can be made between the two large classes of chemicals, film formers, and volatile neutralizers.

When properly selected, applied with the help of experienced consultants, and carefully controlled, the chemical program will be completely successful and inexpensive.

Complete and careful consideration of all the facts, utilization of the best methods obtainable, and intelligent application of the resulting program will definitely lower operation and maintenance costs. Increased equipment reliability and operating efficiency make reduction of these costs possible.

The Continuous Preparation and Application of Silica Sols in the Paper Industry, L. L. Klinger

The development of the continuous preparation of silica sols was begun in 1945 and was carried on by a leading manufacturer of proportioning equipment to a finished and efficient process. The purpose for continuous preparation is threefold, viz.: (1) simpler automatic operation, (2) less labor requirement, and (3) more compact equipment requiring a minimum of floor space. Although the process has been extensively investigated and proved in the treatment of mill process water, indications are

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The Accelerated Biological Oxidation of Kraft Mill Effluents, F. W. Bishop

As a result of the laboratory and pilot-plant work of the National Council for Stream Improvement and with their guidance, Southland Paper Mills has installed a full mill scale treatment plant employing the aeration process for accelerated B.O.D. reduction of kraft mill wastes. This reduction occurs at a high rate when the waste is exposed to sufficient quantities of diffused air in the presence of acclimated bacteria with nitrogen being fed to sustain the activity of the seed. In this instance, the waste originates from the decker seal pit with a B.O.D. range of 200 to 500 p.p.m. With the incoming strength sustained at 200 p.p.m., an operating reduction of 85% can be expected, and with a strength of 500, a reduction of 60% is more general. A properly designed system can be operated with a minimum of attention and maintenance.

With the use of some idle and existing equipment this installation was made and started up at a minimum cost. The process is described in detail with the use of a schematic flow diagram and many of the operating problems are discussed. Among these are foam handling, air requirements, sedimentation difficulties, and some remarks about maintaining the activity of the microorganisms of the seed sludge.

Further advantages can be derived when this process is employed in conjunction with impounding or detention basins where B.O.D. reduction occurs naturally at a much slower rate. When the clarified effluent from the accelerated process is added to larger volumes of raw waste, the oxidation rate of the mixture is greatly stimulated, reducing the detention period requirement by as much as 75%. It is the opinion of authoritative observers that this installation has proved the feasibility of the accelerated process within the bounds of economic justification.

The Aerobic and Benthal Oxygen Demand of Paper Mill Waste Deposits, Nicholas J. Lardieri

The experiments reported in this paper were performed to ascertain the oxygen demand of sludge deposits resulting from the discharge of paper mill waste waters in streams. These sludge deposits decompose through a combination of aerobic and anaerobic processes which has been termed "benthal decomposition."

The benthal oxygen demand of sludges from existing stream deposits was studied in the laboratory under simulated stream conditions. A constant flow apparatus was developed which permitted a measure of the oxygen utilized and gas produced by the deposit to be made.

It was found that these sludge deposits were uniformly low in pH (4.3 to 5.0) and that the pH did not rise appreciably even after 150 days of benthal decomposition. There were only small amounts of gas produced from these acid deposits due to the unfavorable environment for methane producing bacteria. When the pH was adjusted to neutrality and the deposit buffered with $CaCO_3$ the oxygen demand of the sludge was increased approximately 100%. This adjustment also caused more than a twofold increase in gas production.

The benthal oxygen demand of sludge deposits is considerably less than the oxygen demand of the sludge when it is decomposed aerobically. The benthal oxygen demand of sludge deposits is a function of the depth of deposit. The oxygen demand of a sludge deposit per unit weight of volatile matter present was found to decrease sharply with increasing depth of the deposit.

The oxygen demand curves of sludge deposits decomposing at their normal pH values (below 5.0) were found to be approximately linear. Their low and constant rate of oxygen demand is thought to be limited by the low pH values. Adjustment of the pH values to neutrality produces what more closely approaches the logarithmic curve associated with biological oxidation.

The Effect of Alkaline Pulping on the Lignin of *Eucalyptus Regnans*, J. W. T. Merewether

Lignin has been isolated from *Eucalyptus regnans*, an Australian hardwood, both by alkaline pulping and by ethanolysis, and the crude lignins purified to yield apparently homogeneous products. In addition, the alkali lignin has been converted to an ethanolysis product and in each case a series of derivatives has been prepared. The analyses of these three series of lignin derivatives suggest that alkaline pulping of *Eucalyptus regnans* results in the elimination of two alcoholic hydroxyl groups and a carbonyl group.

Factors Influencing Selection of Modern Rotary Lime Recovery Kilns, W. H. Tock

While other equipment such as the multiple hearth furnace, Fluo-Solids unit, and the flash drier have been tried, the rotary kiln because of its ease of operation and high capacity continues to be the most feasible and economical lime sludge recovery unit.

Of all of the types of equipment employed to reburn lime sludge, the rotary kiln has proved a natural process machine for lime recovery.

Used first about 1920, today approximately 100 rotary kilns are in operation in pulp mills in the United States and Canada.

These rotary kilns range in size from 6 to 11 ft. in diameter and from 100 to over 300 ft. long.

The installed capacity per kiln ranges from 25 tons of kiln product per day to over 200 tons.

Prior to World War II very few rotary kilns had heat recuperators but now most of the new installations are made with kilns incorporating heat recuperating chain systems in the kiln feed end.

The fuel consumption in rotary kilns ranges from approximately 7,500,000 B.t.u. to over 20,000,000 B.t.u. per ton of kiln product.

In selecting the kiln the size is dependent upon the capacity requirements and the type of kiln installed is dependent upon the capacity as well as an established basis for considering the economy of operation.

Of recent consideration, the process of pre-pelletization of lime sludge with subsequent calcination on a traveling grate appears worth additional investigation. This process equipment can produce lime for approximately half the fuel requirements in the most economical kiln but the mechanics of handling and the physical characteristics of the calcined lime have yet to be investigated.

The Use of Peabody Scrubbers on Lime Kiln Stack Gases, P. C. Mockridge

The problem of collecting dust from lime kiln stacks is discussed and the inherent advantages of a high efficiency scrubber shown. The Peabody scrubber has been installed at a number of mills and a typical unit is described including specific information as to efficiency, size, pressure drop, and operating principle.

Effect of Bark in the Sulphate Pulping of a Northern Oak Mixture, K. J. Brown

Sulphate pulps of bleachable and semichemical grades were made from mixtures of red and white oak (*Quercus* sp.) chips from Michigan containing up to 24% of bark by weight. These tests showed that the presence of bark caused (1) a decrease in yield of pulp obtained from a digester charge but an increase in yield of pulp obtained from a cord of rough pulpwood, (2) an increase in the amount of active chemicals consumed, (3) a decrease in pulp brightness, and (4) a decrease in the strength properties of the pulp. Sulphate pulping of the bark alone was found to be impractical because of the low yield and poor quality of the pulp obtained.

Bleachable pulps, made from mixtures containing 0 and 16% bark, were cleaned in a centrifugal cleaner before they were bleached by a multistage process to a brightness of 82%. There was very little, if any, difference in appearance between the two pulps. The over-all yield of pulp obtained in these experiments indicates that about 3% more bleached, cleaned fiber can be obtained from a cord of rough pulpwood of 16% bark content by not removing the bark. Furthermore, after cleaning and bleaching, the strengths of the pulp originally containing 16% bark had increased considerably, probably due to loss of ray cells and nonfibrous elements in cleaning.

The sulphate semichemical pulps, with or without bark, made in a yield range of 75%, were much too weak for use in paper products.

Measurement of Wet Web Strength, L. M. Lyne and W. Gallay

The development of an apparatus for the measurement of the tensile strengths of very weak papers, particularly wet webs is described.

Improvements over instruments previously developed for these measurements include magnetic quick-release clamps which grip the paper at right angles to their direction of stress, continuous chainomatic loading at various speeds over a wide range of stresses, continuous recording of stress and strain by electrical and photoelectrical means which do not detract from the precision of these measurements, electronic magnification of stress and strain values, and of major importance, the complete absence of distortion of the weak webs over their entire test zones. Calibration of this apparatus for stress and strain and the establishment of the actual length of the test strips undergoing stress and strain are described. The standard procedure for the preparation of wet webs is described, and the coefficients of deviation for this standard method are given. Typical stress-strain curves for groundwood, wood pulps, and synthetic fibers are given. The necessity for determining these values over a range of moisture contents of the wet webs is discussed.

Interpretation of these results will be given in the subsequent paper entitled, "Studies of the Fundamentals of Wet Web Strength."

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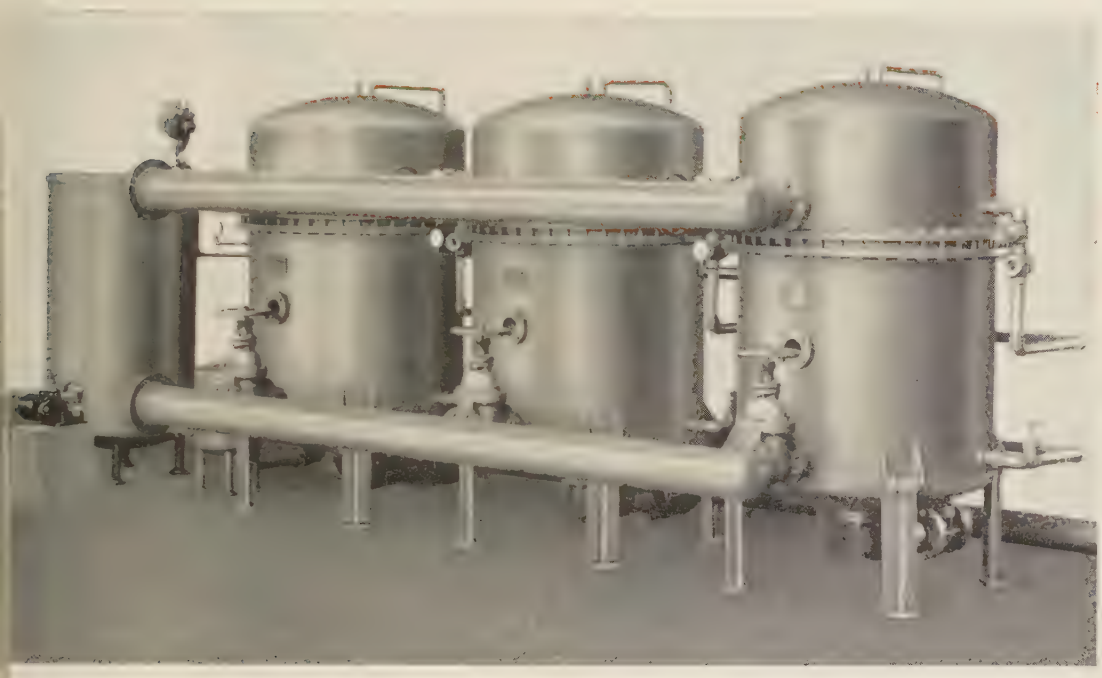

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where water from settling pond or crude filter needs polishing to remove all solids.

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Water filtration with the Adams Poro-Screen or Poro-Stone Filter takes out price-lowering impurities *before* they become part of the stock. Thorough backwashing effectively prevents clogging of filter elements — avoids costly, cumbersome cleaning operations.

Remember — in its early stages your product is about 98% water, and most water-borne impurities stay with the stock.

Write for literature and sample specifications.

ADAMS PORO-STONE FILTER for automatic filtration

where turbid water must be cleared of all solids larger than 0.0005".

R. P. ADAMS CO., INC. 236 EAST PARK DRIVE, BUFFALO 17, N. Y.

Studies of the Fundamentals of Wet Web Strength, L. M. Lyne and W. Gallay

The foregoing paper entitled "Measurement of Wet Web Strength," describes a continuously recording instrument for the measurement of the stress-strain properties of wet webs in tension. Detailed investigation of tensile strength at low solids content showed a pronounced inflection in the relationship between tensile strength and solids content of wet web sheets formed from groundwood and chemical pulps. The influence of various physical characteristics of the sheet and of the liquid medium used in relation to the course of the tensile curve with change in moisture content is described.

Model systems of glass fibers in water and other media were also studied. The effects of freeness, surface tension of the medium, liquid film thicknesses, caliper changes, void spaces, water to fiber ratios, fiber surface areas, fiber thicknesses, and fiber lengths on this inflection point are given. A preliminary study of the stress-strain relationships of these natural and synthetic fibers is also described. Some conclusions on the underlying mechanism of wet web strength development are drawn, and possible practical applications are mentioned.

The Chapman Printing Smoothness Tester. Part I—Basic Development and Recent Modifications, S. M. Chapman

The importance of smoothness as a printing property of paper has long been recognized. Depressions in the surface of the paper may fail to touch the ink film on the printing surface and the resulting lack of ink transfer leads to white areas in the print. A measure of the amount of contact with a smooth surface would therefore seem to be a desirable method of measuring smoothness from the standpoint of its effect on printing.

During printing, paper is subjected to considerable pressure which, due to the compressibility of the paper, leads to increased smoothness. Since it is difficult to correct for this compressibility effect it would appear to be desirable to measure the smoothness under pressures comparable to printing pressures.

Printing smoothness is therefore defined as the fraction of the surface which can be brought into contact with a smooth surface pressed against it under pressures comparable to printing pressures.

An instrument designed to measure this property by an optical method was disclosed in a previous report from the Pulp and Paper Research Institute of Canada. The present paper reviews the theory of the method and discusses its theoretical shortcomings. One of these is the fact that the paper surface must make optical contact with a glass surface in order to register as contact. In printing, on the other hand, the paper surface need only approach the printing form to within the thickness of the ink film. This fairly fluid film can move about under the printing pressure and flow into very small depressions in the surface. Some experiments were carried out in which attempts were made to simulate, in the test, this action of the ink film in printing.

Recent modifications to the original instrument are also described. These improvements have resulted in making it direct reading and more readily standardized.

The Chapman Printing Smoothness Tester. Part III—Design and Use of a Direct Reading Tester, D. Noel Obenshain

This paper covers the design, construction, and use of direct-reading Chapman printing smoothness testers built by the West Virginia Pulp and Paper Co. at its Luke, Md., research laboratory. Five of the instruments have been built to date for use in the company's laboratories. Considerable work has been done with the original tester.

The instrument is a rugged, compact, self-contained unit which automatically indicates on an easily read dial the Chapman F value of the sample of paper clamped therein.

All controls are conveniently arranged for ease of operation. Special design features make the instrument substantially immune to damage by accidental misuse.

Data presented on operation of the tester show very good correlation with printability.

Included are some photographs of typical paper surfaces as viewed through the Chapman tester and the same papers as viewed through a low-powered microscope with the surfaces illuminated at a very flat angle.

The calculations for a typical dial calibration, and a complete list of parts for the instrument, are given in an appendix.

New Gloss Tests of Paper Products, Richard S. Hunter

Within the past year, manufacturers of three different paper products have approached the Hunter Associates Laboratory requesting help in selecting methods for measuring the gloss of their products. In two of the three cases, new measurement procedures had to be developed. In the third case, one of the two standard TAPPI methods for gloss proved suitable, but a special technique had to be developed for mounting and exposing the specimens, which in this case were waxed paper cups. It is believed that the members of TAPPI may be interested in the apparatus and procedures used to select these new methods of gloss measurement.

Although gloss is a consequence of the capacity of surfaces to reflect light in and near the specular angle, there is no specific reflectance function which can be used for the gloss differentiation of all types of surfaces. The capacities of surfaces to reflect light in and near the specular angle vary greatly, even for specific orientations and directions of incidence. As a consequence, the best that can be done for practical routine measurements of gloss is to find for each different class of surface the specific conditions of reflectance measurement which most closely reproduce the gloss ratings made visually.

In the present investigation involving three types of papers newly studied for gloss and two types previously measured, it has been shown that:

1. TAPPI method T 424 m-45, based on the Ingersoll glarimeter is, as intended, well suited for rating the tendency of uncoated papers to glare.
2. TAPPI method T 480 m-51, known as the modified Oxford or Bausch and Lomb method, is also well suited for the purpose for which it was designed, namely to differentiate coated book papers.
3. This same 75° method appears well suited for rating the gloss of waxed drinking cups, provided precautions are taken to limit the area of each cup exposed to an essentially flat narrow strip along the side.
4. For the most effective gloss differentiation of waxed bread wrappers, specular-reflectance measurements at an angle less than 45°, with receptor field angle about 4° wide seem to be indicated.
5. For the surfaces of very glossy, cast-coated, lacquered, and similar paperboards, reflectance measurement for gloss must be made with very narrow field angles (not more than 1° total). To give cast-coated surfaces their proper rankings relative to other high-gloss coatings, a specular angle of 60° seems best.

This trend toward multiplicity in methods of gloss measurement will obviously be disappointing to paper technologists seeking simplicity. However, the increased variety of gloss tests may be counteracted in part by new instruments, such as the multiangle glossmeter which is suitable for a wide variety of measurements of gloss.

A Study of the Effects of Instrumental Variables on 75° Specular Gloss, L. W. Zabel and W. A. Wink

The work presented in this report was initiated for the purpose of determining the effects of instrumental variables on specular gloss measured in accordance with the TAPPI Tentative Standard T 480 m-51. The work resulted as a consequence of difficulties experienced in standardizing several instruments based on the TAPPI Standard. The investigation covers the effects of the following instrumental variables on the gloss: (1) the incident angle, (2) the receiving angle in the plane of measurement, (3) the receiving angle in the plane perpendicular to that of measurement, (4) the diameter of the receptor aperture, (5) the position of the image of the source, (6) the size of the image of the source, (7) the distance from the test area to the incident lens, (8) the size of the source aperture, and (9) the spectral characteristics of the receptor. The results of this investigation indicate the desirability of reducing the tolerances below those listed in the TAPPI Standard. A suggested set of tolerances are listed below:

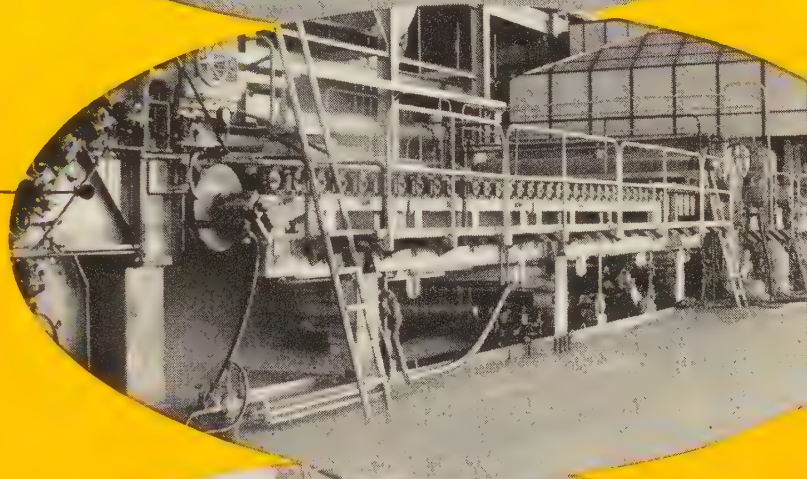
Instrumental variable	*Tolerances in TAPPI arbitrary units, dimensions, and ratios*
Angle of incidence	75° ± 0.1°
Receiving angle in the plane of measurement	75° ± 0.04°
Receiving angle perpendicular to the plane of measurement	0° ± 0.08°
Diameter of receptor aperature	0.2 ± 0.00012
Position of the image of the source	At receptor aperture ± 0.06
Image size	0.10 ± 0.0007 × 0.05 ± 0.0007
Source aperture size	0.25 ± 0.0006 × 0.15 ± 0.0006
Spectral response	The product of the CIE luminosity and illuminant A distribution functions should be matched closely
Photocell and indicating meter	±0.5% of full scale

An instrument meeting these specifications has been constructed. Preliminary tests on the new instrument indicate gloss values obtained with it are in close agreement with those obtained by the National Bureau of Standards.

from pulp to paper products

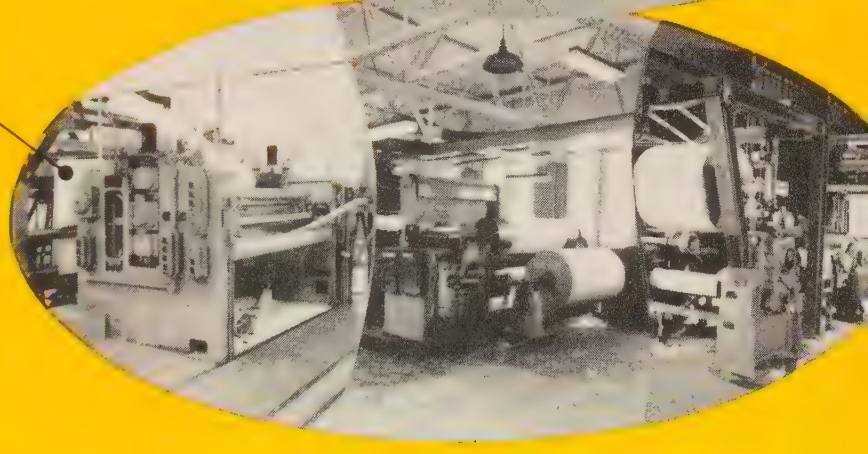
RELY ON A SINGLE SOURCE

ock preparation



paper machine

converting



ck-Clawson, with its Shartle and
lts Divisions, is the one source
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ill or converter's equipment list can
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stands on the rock of long experi-
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rugged action

Heppenstall CHIPPER KNIVES
durable blades for industry

Many leading pulp mills make Heppenstall their stand
ard specification for chipper knives. Heppenstall's recor
for durability provides such production advantages as

- MORE CUTS BETWEEN GRINDS
- LESS OVERSIZE CHIPS
- LESS DOWN TIME
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The reasons may be found in Heppenstall's high stand
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knives. Made from high quality, electric inductio
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Make Heppenstall *your* standard specifications.

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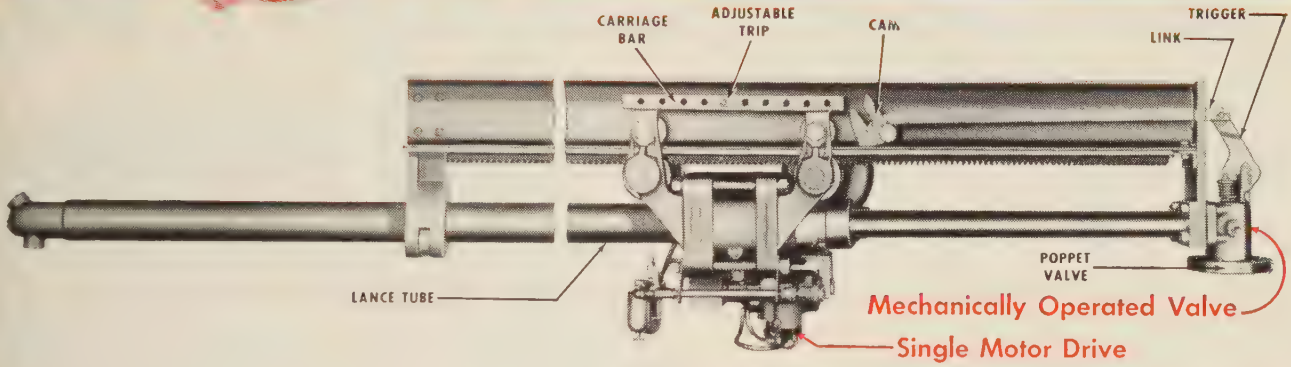
Sales offices in principal cities

ONLY DIAMOND Model IK BLOWERS GIVE YOU THESE THREE

Single Motor Drive

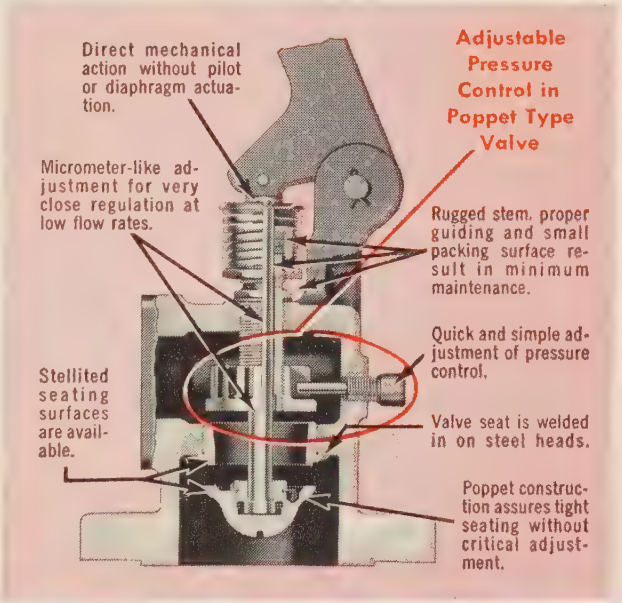
Mechanically Operated Valve

Adjustable Pressure Control



The Diamond Model IK Long Travel Retracting Blower does an efficient job of cleaning tube banks of all kinds. It is particularly suited to locations where gas temperatures are too high for permanently installed multi-nozzle blower elements. It cleans by action of powerful jets from the end of a traveling and rotating lance tube. The close, helical blowing pattern (a sweep every inch) thoroughly cleans soot, dust, and most slag deposits over a wide radius.

The three features described here are all vital to the economy and dependability of any long retracting blower. ONLY Diamond Model IK gives you these THREE.


Direct mechanical action without pilot or diaphragm actuation.
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Adjustable Pressure Control in Poppet Type Valve
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
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If you must repair or replace your sulfur burner, combustion chamber or gas coolers, use Ansul liquid SO_2 and keep your mill operating at capacity.

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4. At a very small installation cost.

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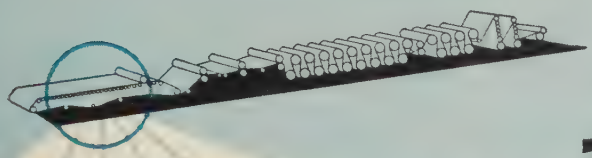
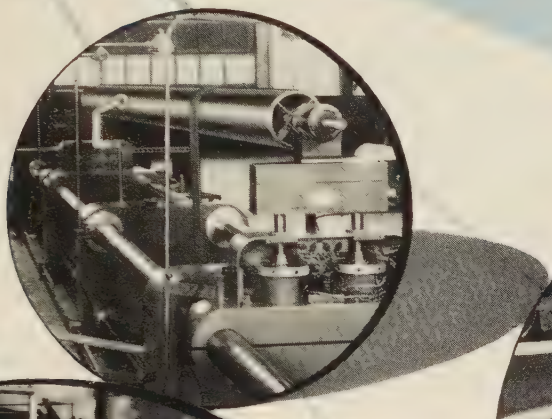
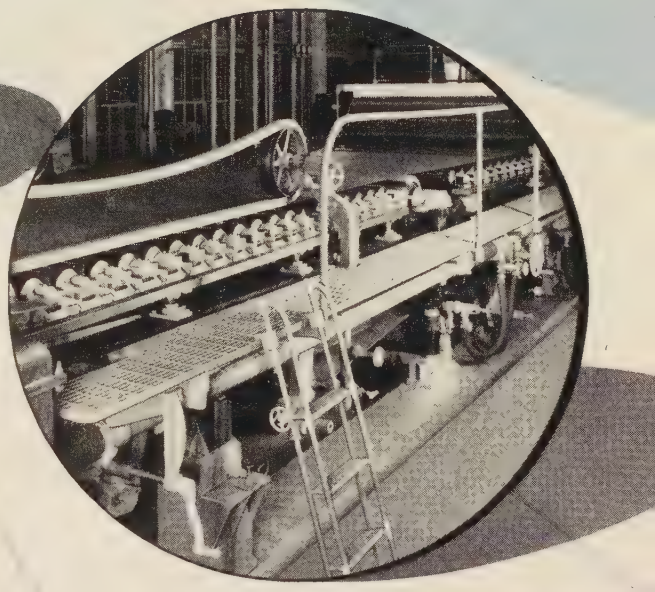
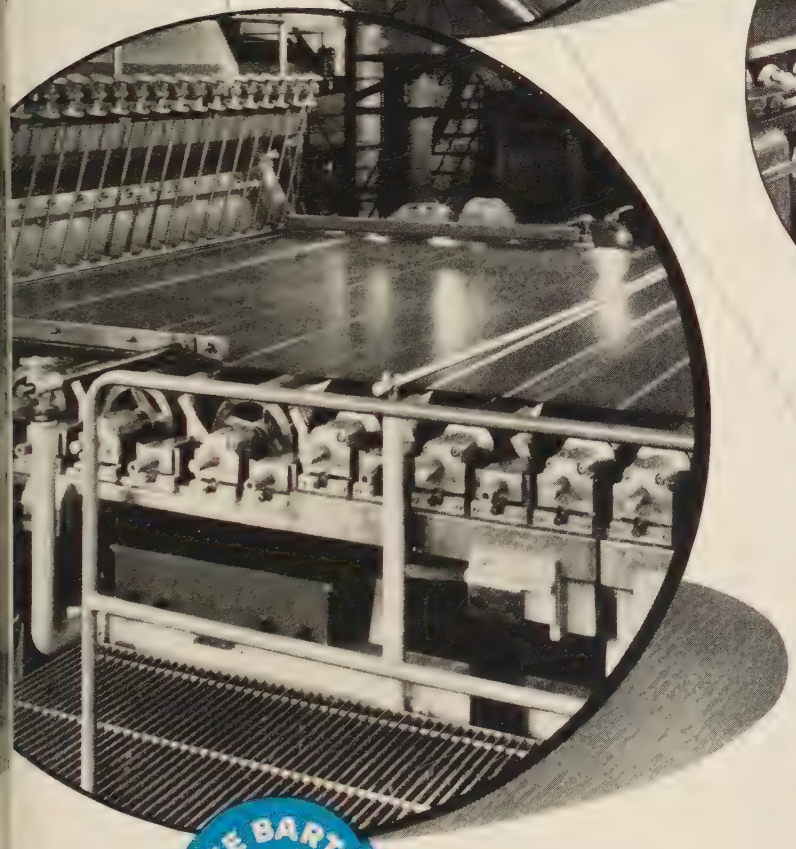


Rice Barton TABLE ROLLS!







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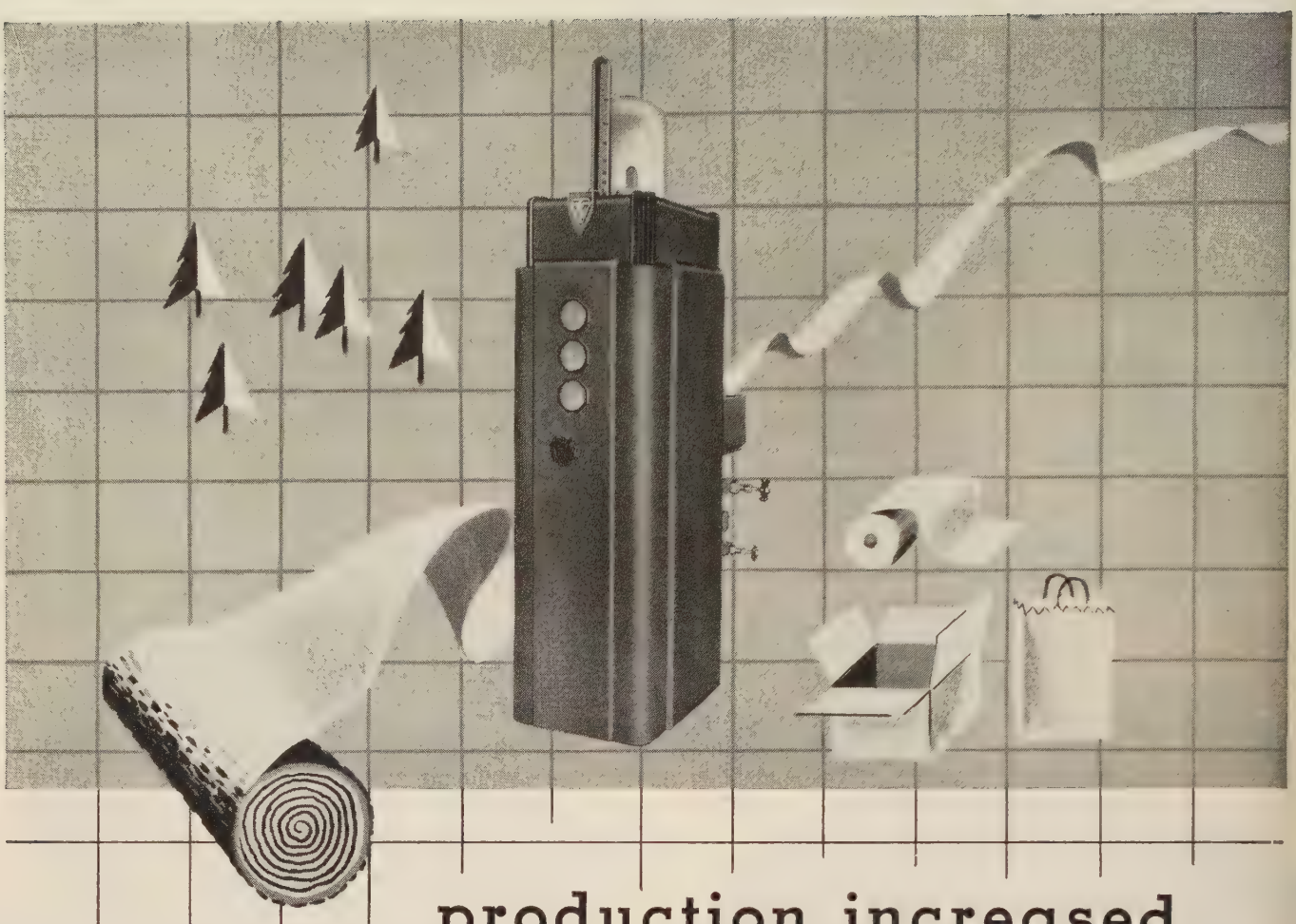

production increased up to 15 tons per day...

. . . with W & T chlorination equipment

A Southern mill had been having trouble with paper breaks attributable to the presence of slime in their white water. Despite continued efforts to control them slime breaks were running 60 to 80 per week, resulting in a time loss of 10 to 14 hours per week, and an average production loss of 15 tons per day! It was then that the W&T man was called in. Where and how to apply the proper treatment was determined, the costly methods were discontinued, and W&T chlorination was installed.

During the first 3 days of chlorination the mill recorded only 1 slime break and 2 minutes of lost time.

During the next 3 days there were 4 breaks and 17 minutes of lost time.

During the next 25 days there were no breaks attributable to slime!

. . . Within a week there were no production losses caused by slime! Performance such as that is typical of what your W&T representative can do for you.

If you have a production problem attributable to impure water, it would pay you to write or call him now.

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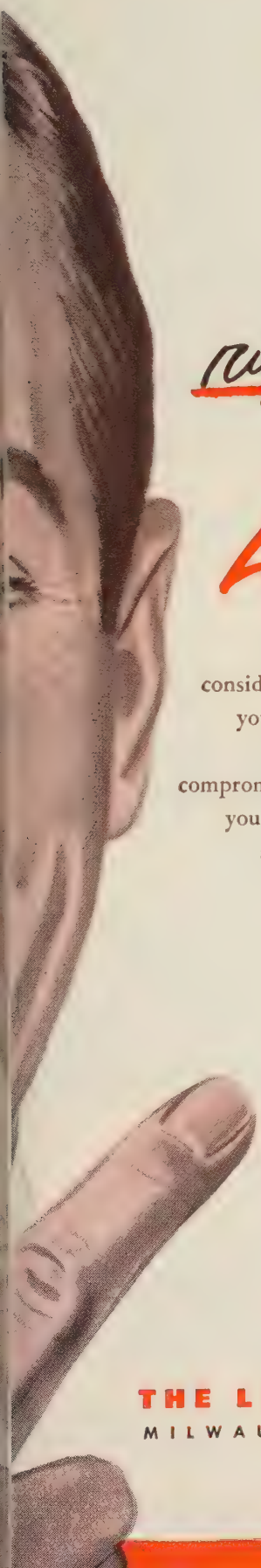

Get the right answer from Louis Allis

It pays to think first of the Louis Allis Co. whenever you're considering adjustable speed drives for your product or plant. Louis Allis builds all basic types. There's no compromising — from this complete line you can select the unit that's exactly suited to your job conditions and engineered for your application.

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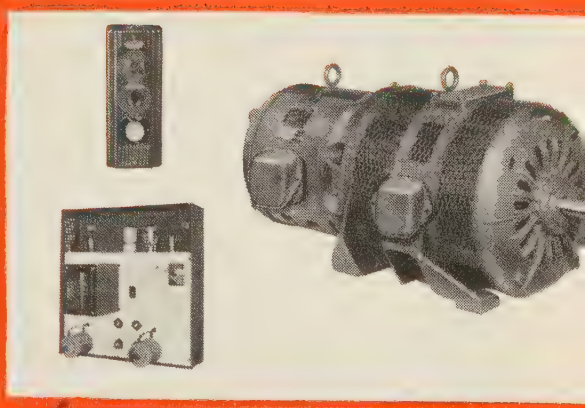
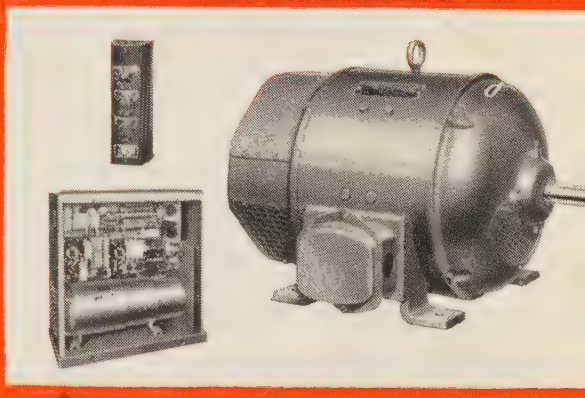
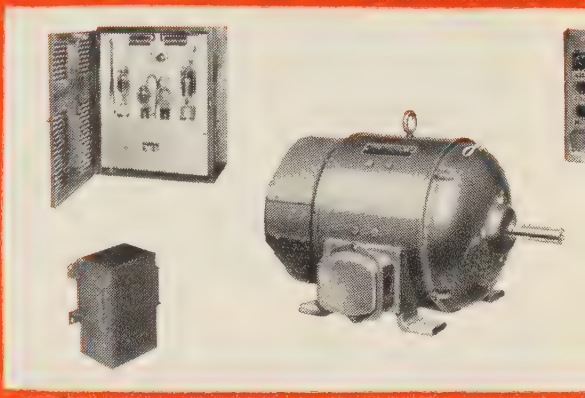


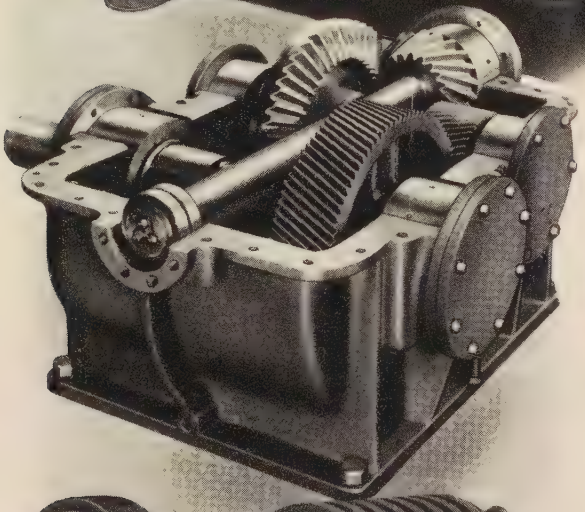
AJUSTO-SPEDE. ¾ to 75 horsepower. A versatile eddy current clutch combined with a constant speed AC squirrel cage motor provides wide, continuous duty speed ranges. Tachometer feedback circuit offers precise speed regulation in an unusually compact drive. Many optional features available — dynamic braking, torque control, threading speeds, inching, jogging, multi-motor operation and range drives.

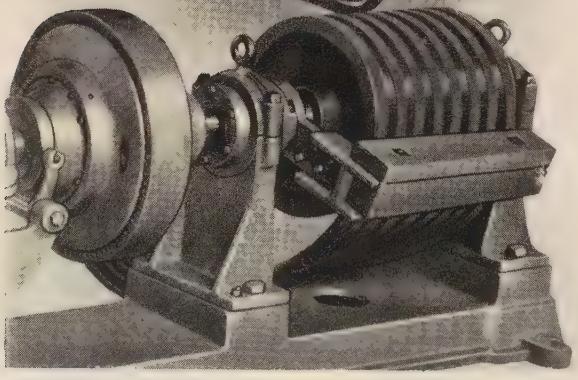


SELECT-A-SPEDE. 5 to 200 horsepower. New magnetic amplifier and adjustable voltage control provide superior speed regulation — better than required on most machines — from ⅛ base speed or less to full base speed. All-electric circuits — easily serviced. A.C. source, converted to D.C. by motor-generator set, drives adjustable speed D.C. motor. Many special control features available — reversing, dynamic braking, jogging, special programming or sequencing control, extra wide speed range. All drive motor enclosure available.



NEW! ELECTRONIC SELECT-A-SPEDE. ¾ to 15 horsepower. D.C. adjustable speed drive motor operates from A.C. electronic power unit. Infinitely adjustable speed ranges 5:1, 20:1, 50:1, 100:1 available. Unusually close speed regulation to ½% with optional tachometer feedback circuit. Included as standard are: dynamic braking, torque limit, line voltage compensation. A few available modifications include: reversing, jogging, threading, and quick slow-down. All motor enclosures and control stations — from open to explosion-proof.





The Sandy Hill Selective Drive

All Sandy Hill Selective Drives were installed and started up and are still running without structural or functional failure.

This reflects the attitude of the company's designers in designing adequately for paper machine operating strains. It reflects the Sandy Hill designers' knowledge of paper mill operating conditions which the drives must meet in order to function without failure or annoyance to the user.

Sandy Hill does not build a cheap drive because it believes that a drive which will last over a long period of years with no more attention than adequate inspection and lubrication is the most economical per ton of paper made.

Features

Unvarying draw between sections.

Fineness of draw regulation.

Simplicity of design that keeps maintenance within the ability of the good paper mill millwright.

Power saving and low first cost to a degree hitherto unknown.

No detectable slippage due to the V-belt feature of the drive.

Saving in space, no basement or mezzanine need for line shaft.

Write on your company letterhead for further information about an adequately designed drive.

Sandy Hill's New Brochure of Pulp and Paper Making Machinery is available on request.

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Machinists and Founders Specializing in Pulp and Paper Mill Machinery

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Adjustable Cylinder Vats
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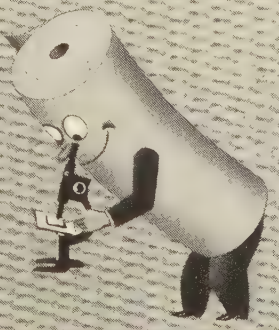
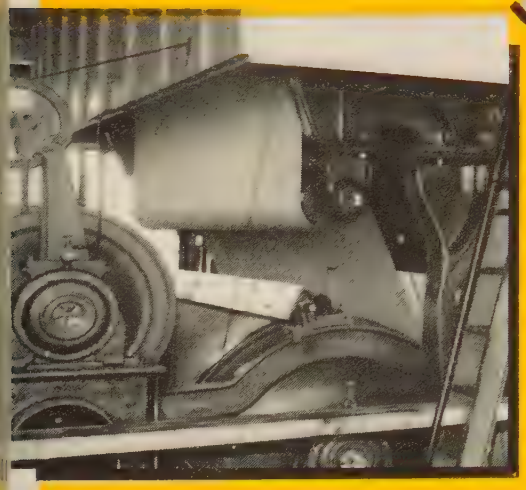
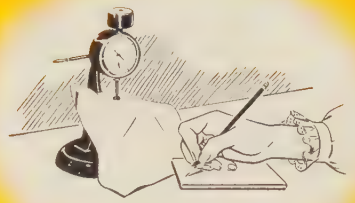


WOODBERRY 887 REINFORCED DRYER FELT GIVES YOU SCIENTIFIC CONSTRUCTION



One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products. Here fabric thickness after weaving is being gauged.



*Asbestos yarns woven into the face of patented Woodberry 887 dryer felts at scientifically determined intervals give you longer wear and smoother operation. Paper mills have learned to count on lowered steam consumption and consistent quality with Woodberry 887. For dryer felts that are low on cost, high on performance, specify Woodberry 887.

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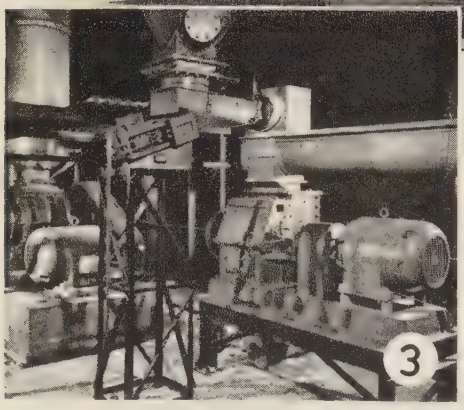

When St. Regis Paper Company designed and built its new kraft mill in Jacksonville, Florida, it selected and installed the Airveyor for handling mill-supply chemicals. Three systems are in use for conveying lime and salt cake for various functions in the mill. This now makes a total of seven Airveyor systems St. Regis has installed in four of its plants.

St. Regis has learned from experience that the Airveyor is engineered and built for superior performance in the pulp and paper industry, as have many others who have continued to purchase duplicate systems after initial installations have proved their worth.

If you handle lime, soda ash, salt cake, starch, clays, and have an unloading or in-plant problem, why not take advantage of Fuller's 27 years of experience in the field of pneumatic conveying. A study of your conveying system will cost you nothing. Write today for complete information.

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1

Unloading pebble lime from cars to storage bin at rate of 10 tons an hour, for water-treatment plant.

2

Unloading pebble lime from cars at rate of 10 tons an hour, delivering to storage bin in causticizing plant.

3

Vibrating pan feeder arrangement delivering salt cake to pulverizer from storage bin. The minus 1/8" salt cake is conveyed to a service bin in the recovery unit by the Airveyor. Exhauster, extreme left, furnishes air for the Airveyor Systems.

4

Unloading salt cake from cars to two storage bins at rate of 10 tons an hour. This same system also reclaims from storage and delivers to a service bin in the recovery building.

A-178
2243

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Quick Check List

OF INSTRUMENTS BY FOXBORO

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INDICATORS • RECORDERS • CONTROLLERS

***Conductivity**

***Consistency**

Density (Specific Gravity)
differential pressure type

Flow
mercury-manometer type
"d/p Cell", force-balance transmitter type
float-and-cable type

Humidity
wet-and-dry-bulb temperature
relative humidity (hygroscopic type)
absolute humidity and dew point temperature ("Dewcel")

Liquid Level or Interface (in open or pressured vessels)
diaphragm type
bubble tube (purge) type
differential pressure type

***Load, Force, and Torque**

***Moisture Content (sheeted materials)**

Motion and Position Recorders

***Motor Load (Power)**

Operation Time Recorders

***Oxidation—Reduction Potential**

***pH (with Beckman glass electrodes)**

Pressure, Absolute Pressure, and Vacuum
spring and hydron types
differential type
*electric pressure cell types

***Resistance (Electric)**

***Speed (R.P.M. or Lineal)**

Temperature
filled-system types
resistance bulb ("Dynalog" electronic and galvanometer types)
thermocouple ("Dynalog" electronic and galvanometer types)

***Tension**

***Thickness (sheeted materials)**

***Viscosity**

***Voltage, Current, Impedance, Dielectric**

***Weight (sheeted materials in process)**

***Weight and Force (strain gauge type)**

**with Dynalog Electronic Instruments*

CONTROLLER TYPES

Pneumatic

Model 40: On-Off
Proportional
Proportional with Derivative
Proportional with Reset ("Stabilog")
Proportional with Reset and Derivative ("Hyper-Reset")
Consotrol (Console/Graphic Panel Types): in all above control mechanisms except on-off

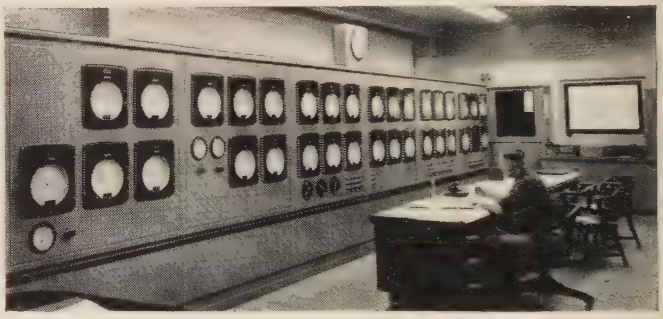
Model 41: On-Off and Proportional
Circular Case: On-Off and Proportional

Electric

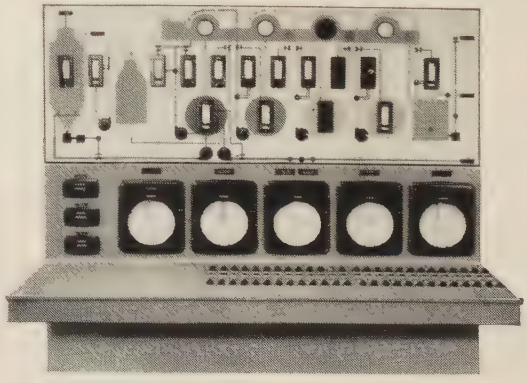
Rotax (rotary contact type)
On-Off
Multi-Position
Galvanometer Type
On-Off
2- and 3-position
Proportioning

CONTROL SYSTEMS

Auto-Selector	Ratio
Averaging	Relation
Dual	Sequence
Duplex	Time Schedule (cam and camless types)
Limit	



Complete Washer and Bleach Control Panel by Foxboro at S. D. Warren Company, Cumberland Mills, Maine.



Foxboro Graphic Panel for centralized control of brown stock washing at Gaylord Container Corp., Bogalusa, La.

THE FOXBORO COMPANY, 785 Neponset Ave., Foxboro, Mass., U.S.A.

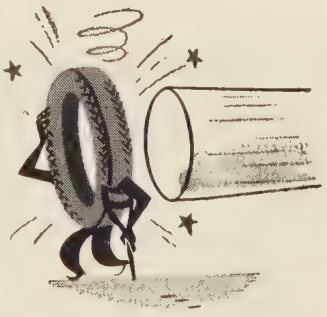
How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

Keep equipment in repair for best packing service

Worn shafts wear me down

Trying to make packing compensate for excessive shaft or rod wear will shorten packing life materially without alleviating the undesirable condition. Pack correctly to avoid excessive shaft and rod wear. Replace worn shafts and rods as soon as possible to avoid adding the expense of damaged packings to the cost of parts replacement.

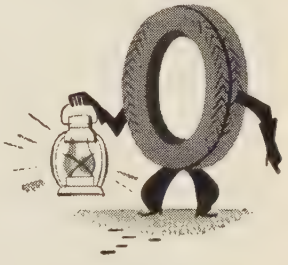


"Bucking" shafts throw me!

Packings are for sealing only. Trying to compensate for shaft misalignment or vibration by overpacking and excessive gland pressure results in scored shafts and ruined packing. Think of a stuffing box as a potential brake assembly that may develop considerable frictional resistance with attendant heat and wear.

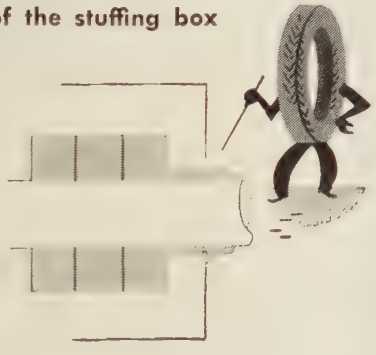
Keep my lantern clear

If the stuffing box is equipped with an oil, grease or water lantern, its purpose is defeated when the lantern ring is omitted or the opening blocked by improperly installed packing or other obstruction. This can deprive the packing of lubrication or cooling and result in premature failure.



Won't let me get out of the stuffing box

If the shaft or rod is badly worn, the packing may be extruded into the system when the gland follower is taken up. Considerable difficulty such as packing getting into valves or traps or contaminating the fluid handled may result. Rebush the stuffing box or use a junk ring to reduce the clearance.



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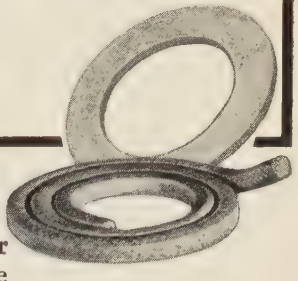

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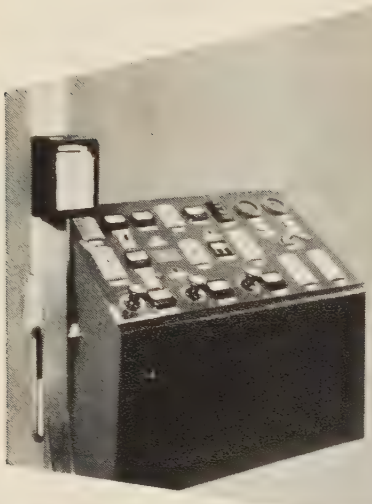

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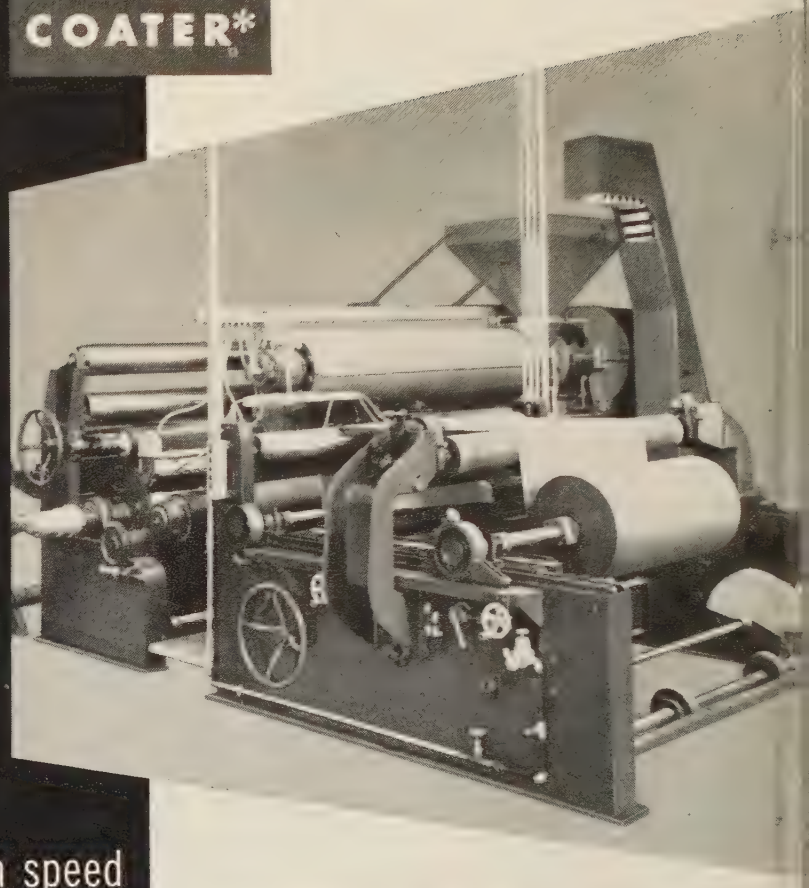

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The polyethylene is extruded from a die and the extruded film is laminated to the paper between the nip of two rolls.

This coater incorporates automatic splicing unroll and reroll equipment for high speed operation.

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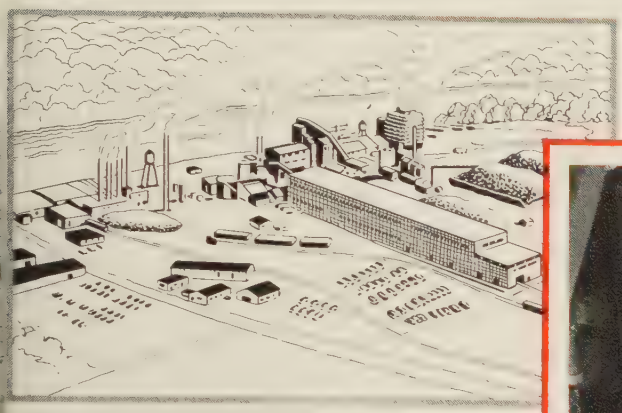
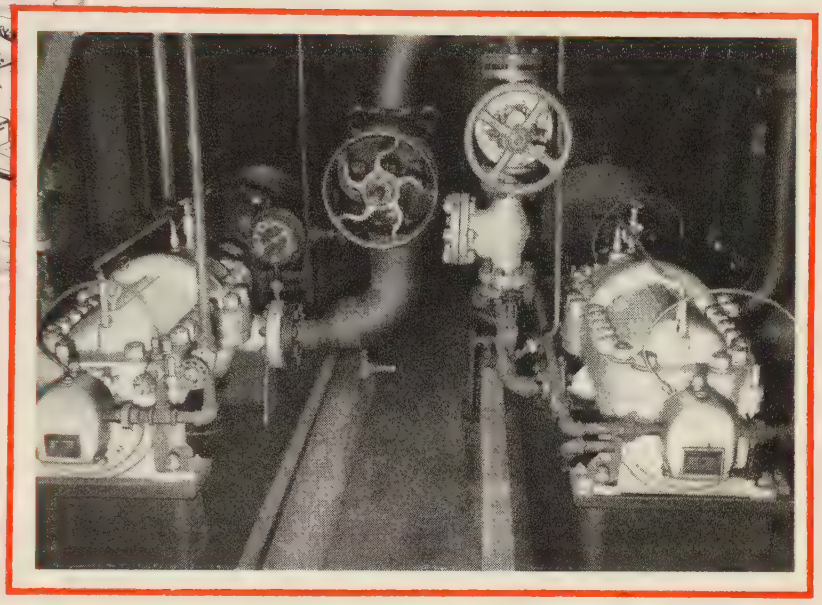
NEW high-production Halifax paper mill installs NEW Class CNTA high-efficiency Ingersoll-Rand BOILER FEED PUMPS



Halifax Paper Company's new plant, with daily capacity of 270 tons, features last word in ultra-modern equipment



. . . including two Ingersoll-Rand CNTA Boiler Feed Pumps

The Halifax Paper Company takes justifiable pride in its new, high-production mill at Roanoke Rapids, N. C. Equipped with the newest Beloit Paper Machine, this ultra-modern plant can turn out 270 tons daily of Kraft wrapping and converting paper. Advanced design is followed through in all of the equipment required for sustained, high-speed production.

Two I-R boiler feed pumps of the new CNTA design with Unit-Type rotor assembly serve the 60,000 lb/hr boiler supplying the paper machine turbine drive. These 1½", 8-stage centrifugal pumps, shown above, deliver 180 gpm of 230° water against a total head of 1400 ft (605 psi).

Twelve other Ingersoll-Rand pumps and three I-R air compressors also serve the Roanoke Rapids mill and a fourth compressor will soon be added.

Ingersoll-Rand CNTA pumps extend to medium-pressure applications the proved advantages of the Unit-Type Rotor assembly—offering higher sustained efficiency, greater dependability and reduced maintenance. They are available in 4, 6 and 8 stages, for pressures to 1000 psi and in capacities to 700 gpm. For further details, consult your nearest I-R representative.

938-10

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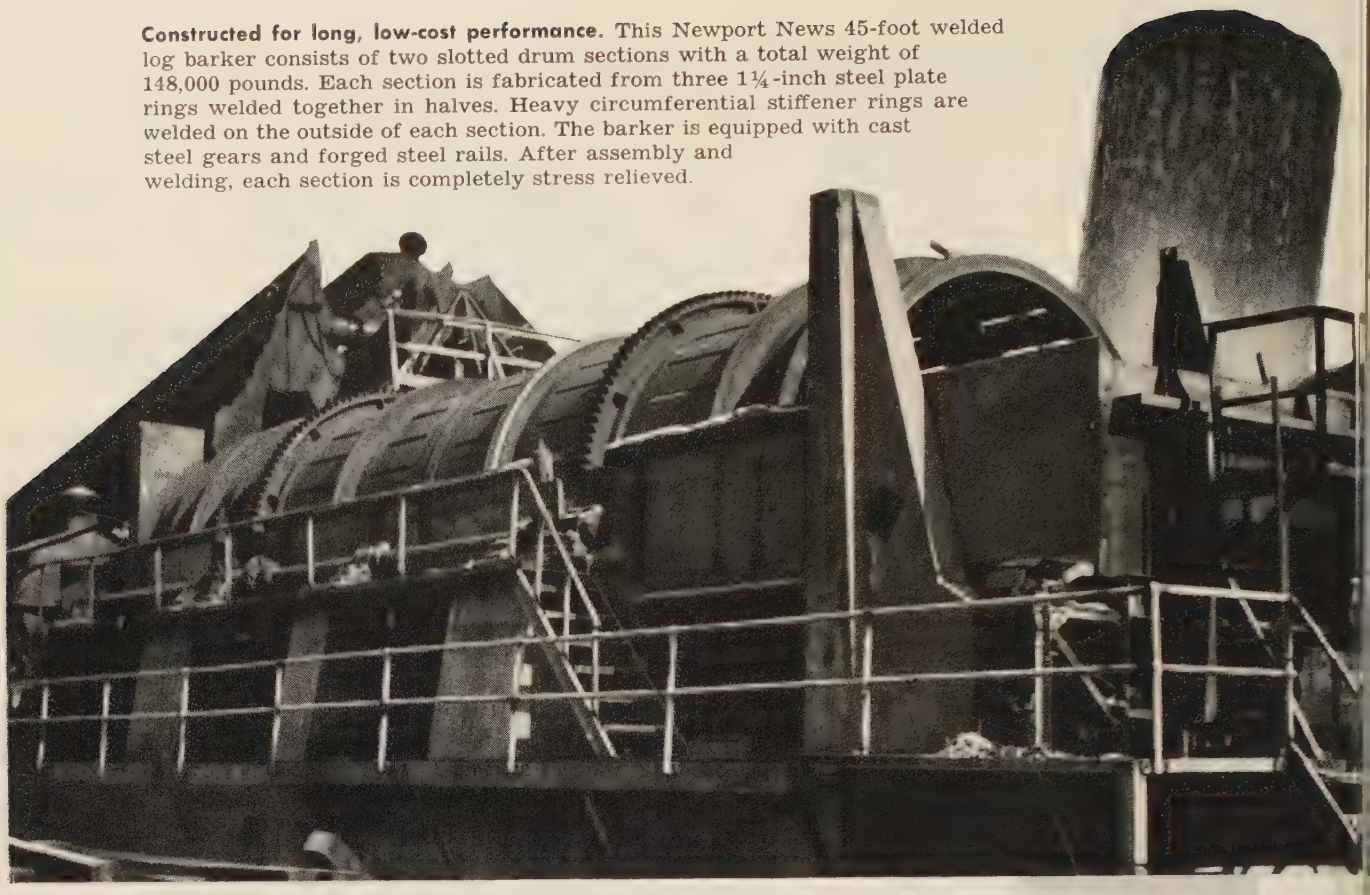
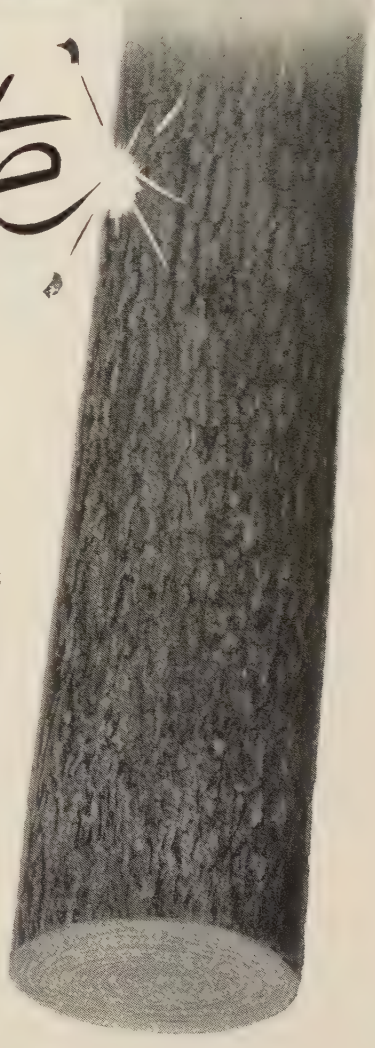


Characteristics that Give a Log Barker Bite



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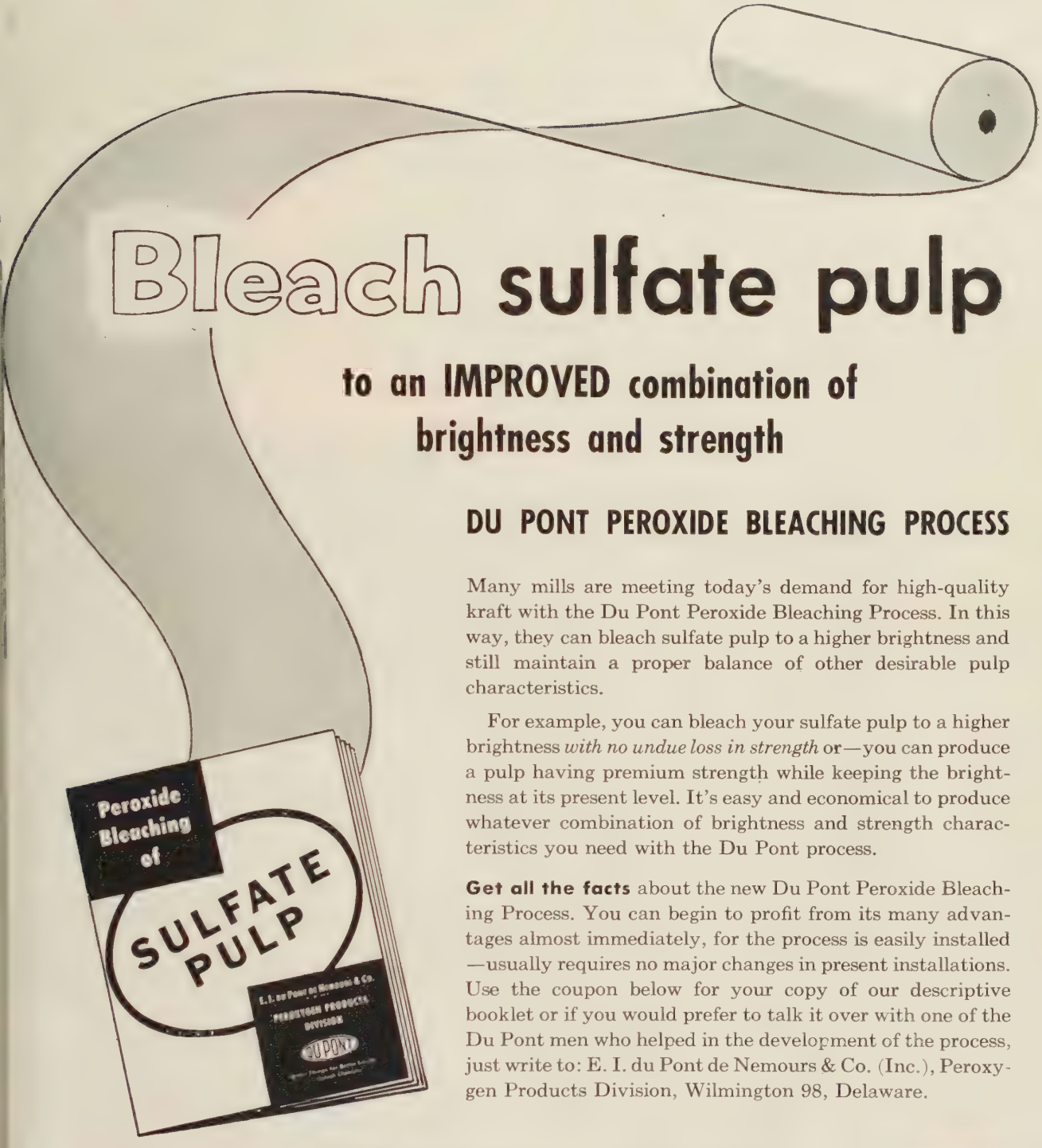

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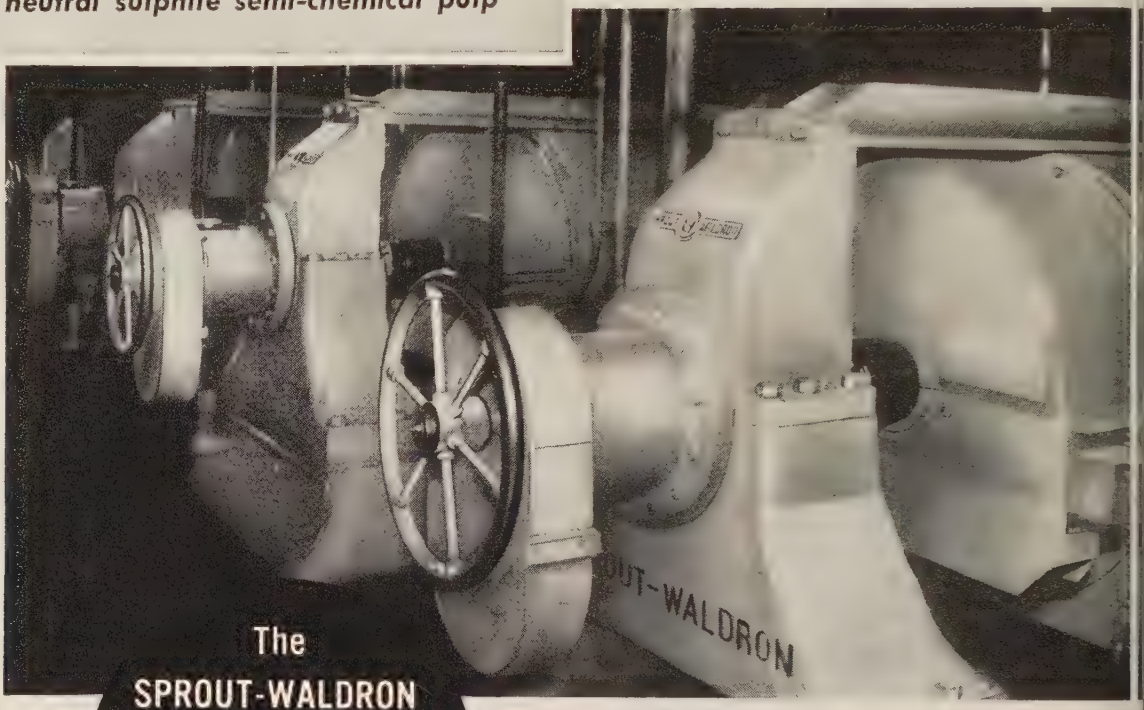

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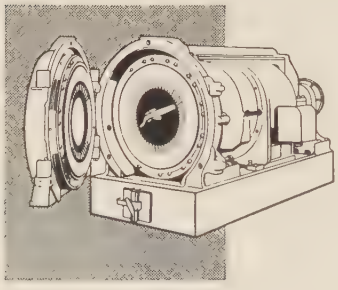

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Aspen, previously considered useless for conventional paper because of its extremely short fibers, is being converted into excellent pulp by CHEMI-PULPER Continuous Digesters at the Filer City plant. These digesters operate on an around-the-clock basis and supply pulp for the papermaking machines.

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Paper Tension Regulators

G. C. EHEMANN and R. C. BERGER

Feed-back control systems in use for regulating tension in a moving web of paper have been examined for fundamental principles. These systems are shown to comprise various combinations of methods of measurement, comparison, and correction. A number of methods of measurement are described schematically. Several examples of complete tension regulating systems are given.

This discussion is limited to feed-back control systems. These are combinations of devices which continuously measure tension, compare this measurement against a standard, and apply a corrective effort if there is a deviation from the standard.

Many papermaking and paper-processing machines have been built in which reasonably constant tension is inherent in the design and operation of the machine. The factors which contribute to the accuracy of tension in such a machine are well worth study, since no regulating device should be used where it isn't necessary. However, if precise control of tension is required or if unregulated tension would tend to swing over wide limits, a feed-back control-type tension regulator may be considered.

A tension regulator, as applied to a moving web of paper or paperboard, involves the same basic principles that appear in every regulating system, whether the controlled variable be speed, temperature, pressure, or any other measurable quantity. It is the purpose of this paper to show how some of these basic principles have been applied.

The first problem in every regulating system is to measure the variable that is to be controlled. This is so fundamental that, before going further, a few of the schemes that have been used for measuring tension should be examined.

The arrangement shown in Fig. 1 is probably the most frequently found mechanical tension measuring device. The position of the roll indicates web tension. The scale of actual tension is a simple function of the spring constant, initial spring loading, and travel of the roll.

Figure 2 shows an obvious modification of the elementary spring-loaded roll shown in Fig. 1. Here also the position of the roll indicates the web tension. The scale of actual tension is a function of the spring constant, initial spring loading, travel of the roll, and the angles between paper travel and spring travel. This device would be characterized by a shorter travel and/or lighter spring than in Fig. 1 for the same paper tension.

Figure 3 shows how linear motion may be replaced with angular motion. This scheme offers the possibility of changing range and/or sensitivity by changing a point to which the spring is connected along the swinging arm.

The mechanism shown in Fig. 4 measures tension by virtue of the fact that it establishes the tension. As long as the roll is within its limits of travel and except for friction and inertia, the tension is a function only of the weight of the assembly.

Figure 5 shows another device that will establish tension. It will take in or pay out web to keep the tension a function of the weighting.

It is not necessary for a spring-loaded roll to extend the full width of the web. Figure 6 shows a small roll with rounded edges mounted on a cantilever spring. The roll is mounted so as to depress the portion of the web over which it runs. The deflection of the spring is a function of web tension. This measurement of tension would be difficult to express in absolute values; it is, however, a very satisfactory measurement for control purposes.

In Fig. 7 the spring of Figs. 1, 2, and 3 has been replaced by a forced balance diaphragm. In the illustration, the tendency of the roll to move to the left, under the influence of the web tension, is opposed by air pressure behind a diaphragm. Unbalance between web tension and air pressure causes a slight movement which opens or closes an air nozzle, restoring the balance. The air pressure against the diaphragm is therefore a measure of tension.

Figure 8 indicates a web under tension traveling over a curved guide plate. In the guide plate there are a number of small holes connected to a pipe manifold. A regulated air supply through a restriction supplies air under pressure to this manifold. Leakage from the holes in the guide plate will be influenced by web tension. The air pressure in the manifold will be related to web tension and can be used as a measurement

If the spring mountings shown earlier are replaced by a supporting member which will deflect a small amount, a variable resistance-type strain gage may be used with a Wheatstone bridge, as indicated in Fig. 9, to measure tension.

Load cells which combine the variable resistance unit and the deflecting member are also available on the market.

Figure 10 shows a pair of rolls driven by a d.c. motor. On the entering side of these rolls, the web is tight under the tension to be measured. On the other side of the nip, the web is free. If the friction load is constant or small as compared to the tension load then the current in the motor is a measure of tension. Note that neither voltage nor speed enters into the measurement.

The scheme shown in Fig. 10 can be reversed to feed a measured tension away from a free loop. The d.c. motor now must become a d.c. generator. The current from the generator is still the measurement of tension.

If the device shown in Fig. 10 is applied as indicated in Fig. 11 where there is tension on both sides of the driven pair of rolls, the ammeter no longer reads the

C. Ehemann, (deceased), Plant Engineer, The Ohio Boxboard Co., Rittman, Ohio; R. C. Berger, Application Engineer, General Electric Co., Cleveland, Ohio.

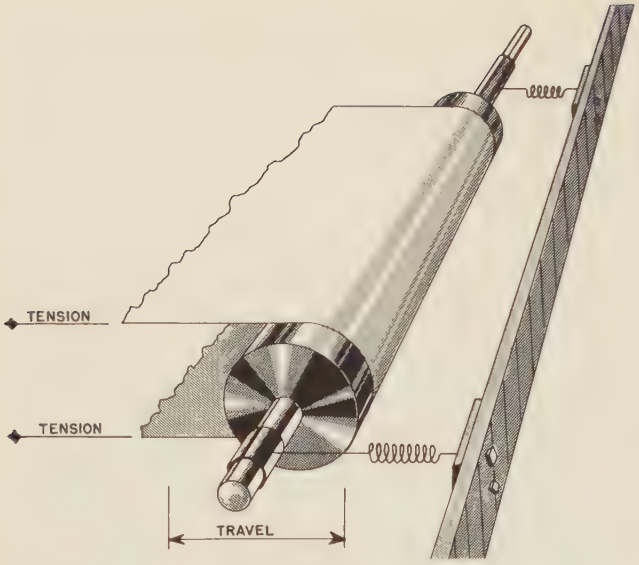

Fig. 1

web tension. The current shown by the ammeter will indicate only the difference in tensions ($T_1 - T_2$).

A surface-wind reel, as indicated in Fig. 12, is quite

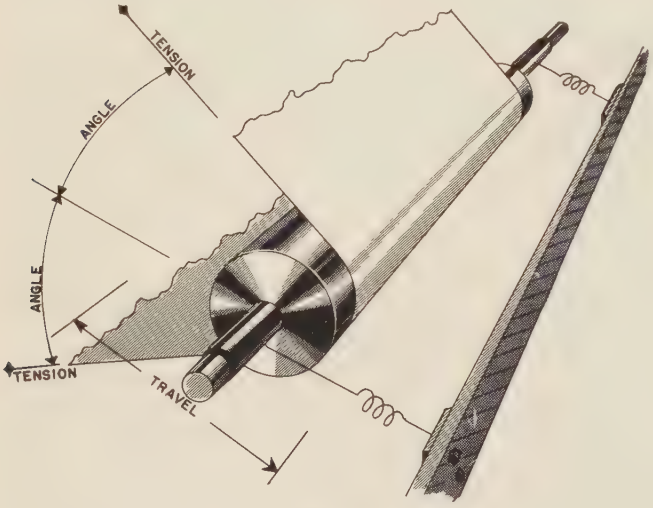

Fig. 2

the same as the pair of rolls with the free loop on one side. In this case also, if friction is small, the ammeter reads tension to some scale.

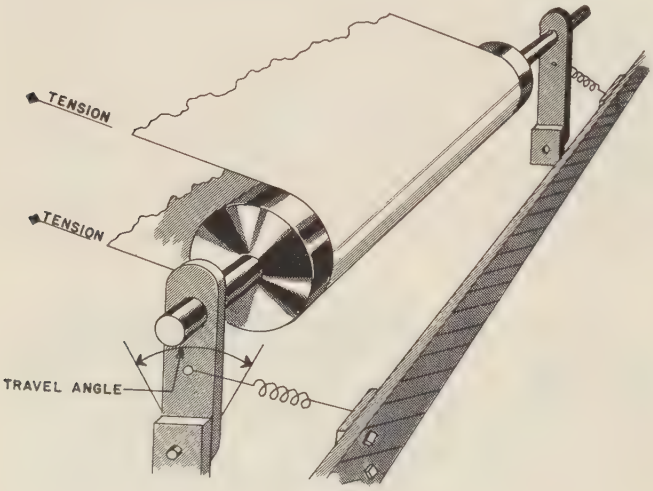

Fig. 3

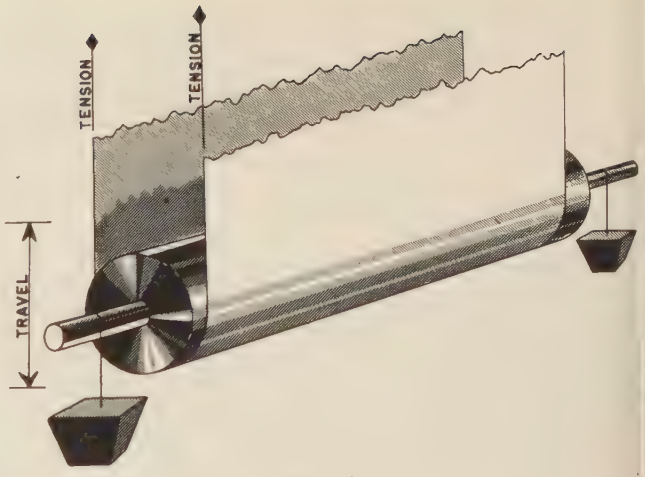

Fig. 4

If a d.c. motor is applied to a center-wind reel, as indicated in Fig. 13, the moment arm through which the motor torque must act is constantly changing as the reel builds up. For a constant paper speed the motor speed is also changing. In spite of these changes it can be shown that, if the motor voltage is maintained proportional to paper speed, the ammeter still reads tension.

The center-wind reel in Fig. 13 becomes an unwind stand if the direction of travel is reversed and the d.c. motor becomes a d.c. generator. The ammeter still reads tension.

In unwinding or winding, inertia is quite often a problem in tension measurement. The torque necessary to accelerate or to stop a roll will show up as a tension error on the ammeter. Several schemes for inertia compensation are in use.

The above schematic illustrations cover most of the basic methods which may be used to measure tension, but the variations of application seem endless.

Having examined methods of measurement, the problem becomes one of assembling a regulator which can use these measurements to control web tension within the required limits.

The regulator may control tension by changing a brake pressure, field strength in a motor or a generator, adjusting a speed changer, or by other means. But between the measurement and the control device are all of the problems of regulators in general; such as the degree of correction to be introduced for a given deviation, time constants, anti-hunt, range, stability, sensi-

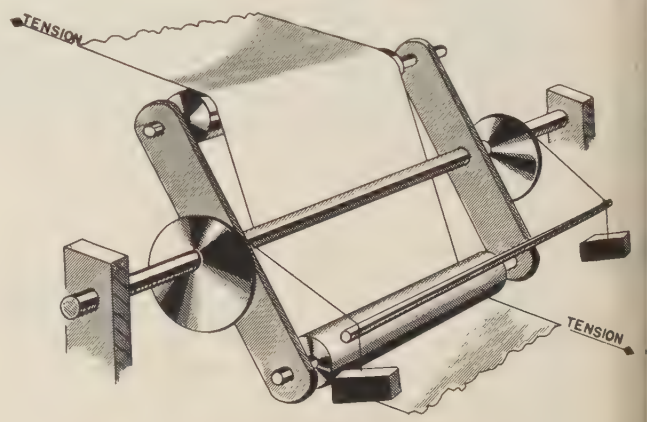

Fig. 5

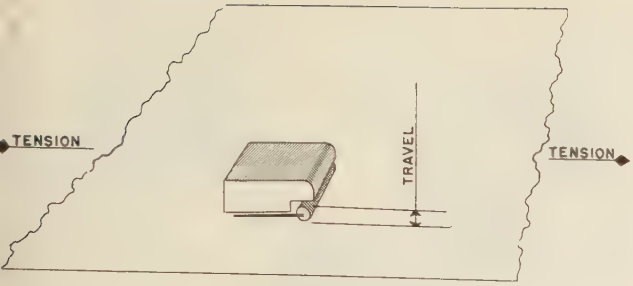

Fig. 6

vity, etc. No attempt will be made to analyze any of ese considerations here. It should be recognized, owever, that they may influence the choice of control heme.

Numerous combinations of elements are possible as dicated in Fig. 14.

This diagram depicts the complete tension regulator, overing "measurement, comparison, and correction." ny of the measuring elements may be used with any of e correcting elements. The control device between ill depend upon the nature of the signal received and on the kind of output required.

A few examples of the many possible combinations rming complete tension regulating systems may be of terest:

Figure 15 represents diagrammatically a simple eumatic tension control system for an unwind stand. nsion in the paper tends to cause the measuring roll pivot about its fulcrum. This tendency is balanced the spring pressure.

The air valve attached to the roll arm is opened or sed an amount which is proportional to the travel of roll arm. Between the valve and brake operator an orifice bleeding air out of the system. For any en spring roll position, the relationship between lve opening and orifice area will establish a certain ssure on the brake operator.

As the paper tension increases during normal unding, the spring will be further compressed and the valve will move toward the closed position. The uced quantity of air coming through the valve will imit the orifice to bleed the system to a lower ssure, thus reducing the pressure against the brake rator. This reduced pressure on the brake will tend offset the increased paper tension. Neither this tem nor any other regulating system will hold con-

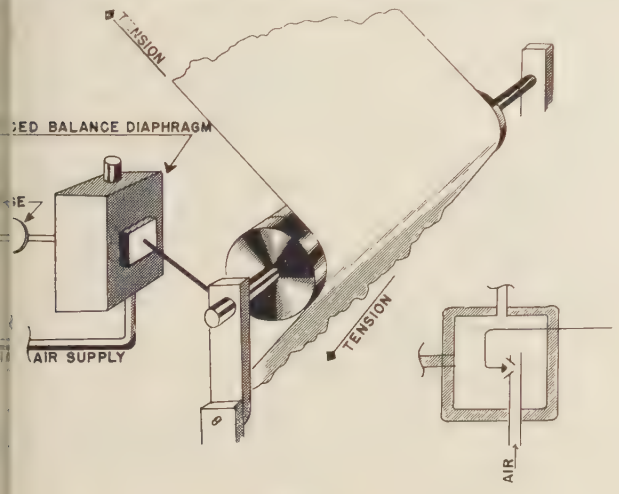

Fig. 7

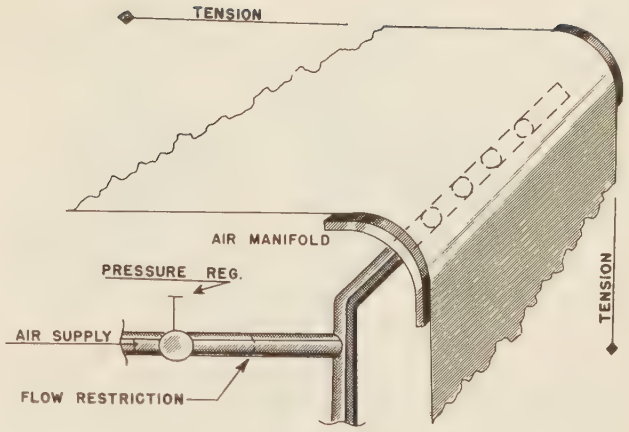

Fig. 8

stant tension. The real question is, "How much will it permit tension to vary?"

Obviously, in unwinding a roll of paper, more brake pressure will be required when the roll is large than when the roll is small. This change in air pressure is obtained by a change in valve position which in turn is obtained by a change in the position of the roll arm. The change in roll arm position is accompanied by a

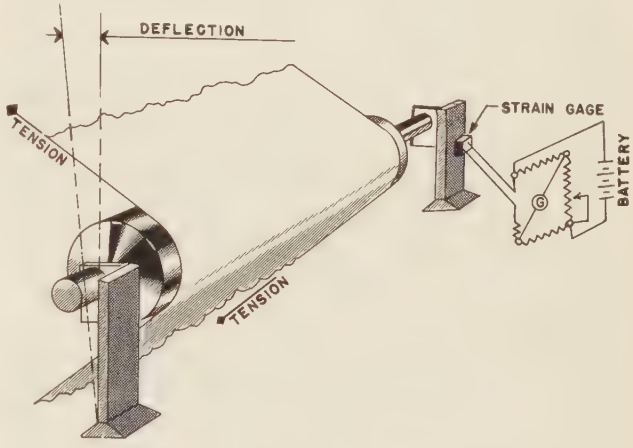

Fig. 9

change in spring pressure which implies a new paper tension for the system to be in balance. In other words, in order to change brake pressure, the paper tension must be permitted to vary. This situation, of course, is common to all proportional controllers.

The magnitude of change in paper tension required to produce a given change in braking effort will depend upon the spring constant, the spring lever arm, the valve lever arm, length of total valve stroke, air supply

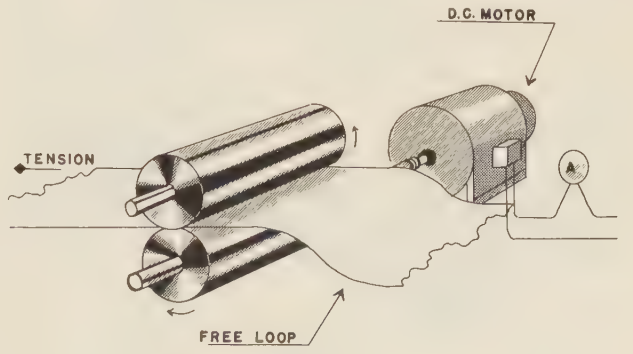

Fig. 10

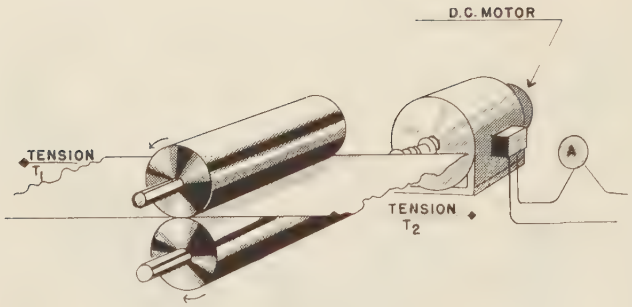

Fig. 11

pressure, ratio of valve area to orifice area, size of brake operator, and the mechanical advantage of the brake.

In order to arrange this device so that only a very small change in paper tension is required between a large paper roll and the core size, the spring constant should be small, and the valve travel should be a large portion of spring roll travel. Such a situation is likely to result in an unstable regulator. This condition also is typical of all straight proportional regulators; that is, the more nearly constant the controlled variable, the more unstable the regulator. The greater the droop (wider proportional band), the more stable will be the regulator.

In a simple system such as that indicated in the diagram (Fig. 15), an adjustable linkage between the roll and the air valve will change the droop of the regulator. This might be called an adjustment of sensitivity or proportional band. In any event, the linkage marked "sensitivity adjustment" on the diagram will control the amount of brake pressure change for a given tension change. This adjustment will usually suffice to make the regulator stable with minimum tension variation.

Within the range of the components of the system, tension may be adjusted by changing the initial spring loading. An increase in initial spring loading would require that a greater paper tension be exerted to move the spring roll and valve to the balanced position.

Figure 16 depicts an all pneumatic tension regulating system for an unwind stand. This system makes use of precise pneumatic control equipment.

The measuring element is the forced balance diaphragm. For very small movements of the measuring roll, this element transmits an air pressure proportional to paper tension. The pneumatic control instrument which receives this tension signal is a standard pressure controller with an adjustable proportional band. It undoubtedly has reset and might, depending upon conditions, utilize derivative.

The output of the control instrument is the standard

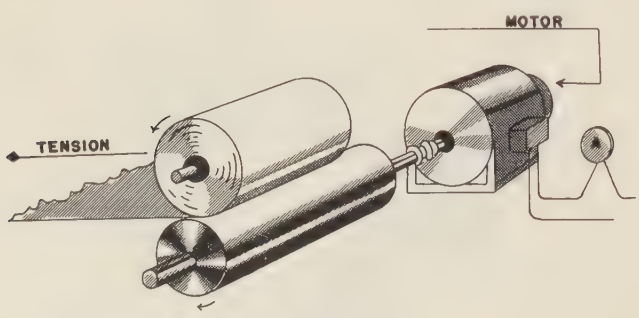

Fig. 12

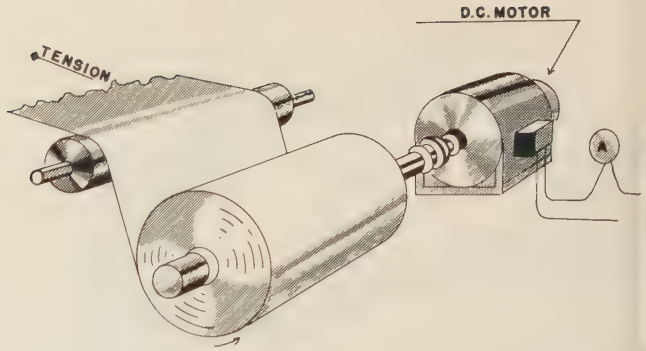

Fig. 13

3 to 15 p.s.i. This output is sent through a ratio transmitter where the output pressure is multiplied in order to keep the brake operating diaphragm small which reduces mechanical problems and time lags.

Adjustment of the total sheet tension is made directly from the control instrument by adjusting the instrument's set point. Stability is obtained by adjusting the proportional band and the droop is offset within the limits of stability by adjusting the reset time. Derivative, if used, would have the effect of temporarily narrowing the proportional band an amount dependent upon the rate of change of tension.

The tension device shown in Fig. 17 belongs to quite a different family from the two preceding illustrations. The rolls on the swinging arms pivot about the center.

The tension in the sheet is established by the weight hung from a cable which is wrapped around a cam on the swinging arm. Disregarding inertia, this device will hold constant tension within the limits of its travel.

In order that it may be a continuous device, a limit switch is contacted by the weight as it nears each end of its travel. Each limit switch operates the adjusting motor in the appropriate direction on a mechanical speed changer.

An interrupting timer has been inserted in the circuit to permit adjustment of the amount of correction that the motor can make in a given time. This will reduce the rate of hunting, but hunting is inherent in the system.

Figure 18 shows an electric drive motor on a center-wind reel at the end of a lineshaft driven paper machine.

In this system, the conventional backstand and slip belt have been replaced with a geared or belt-driven generator. The center-wind reel motor is electrically connected through a booster generator to the lineshaft generator. The booster generator supplies the d.c. loop circuit IR drop, thereby causing the voltage applied to the center-wind reel motor terminals to be directly proportional to lineshaft speed.

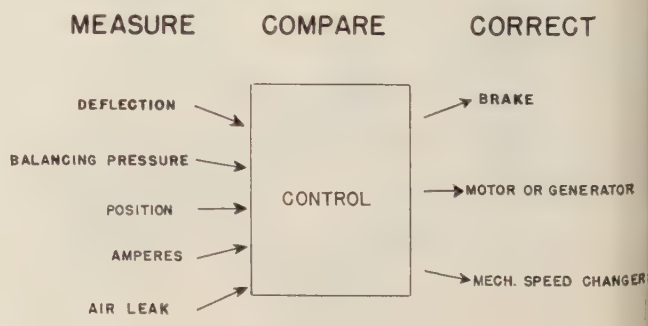

Fig. 14

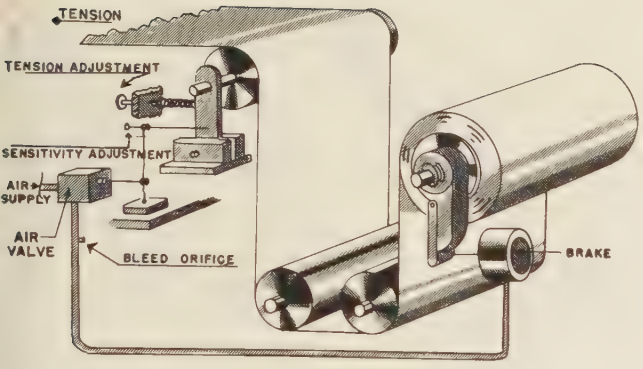

Fig. 15

The armature current in this system is directly proportional to paper tension except for friction losses. This current is measured as a voltage drop across a resistor connected in the armature circuit. The voltage thus obtained is then compared with a reference voltage in the regulator. The reference voltage is adjustable and is the means whereby the value of tension can be varied. The difference between these two voltages is then amplified and the output of the regulator then establishes the controlling effort on the field of the center-wind reel motor.

The horsepower characteristic of a center-wind reel drive is constant. At core size the mandrel rotational speed is high and, since the moment arm from the center to the surface is small, the torque is low. Conversely, at full reel, the rotational speed is low and the torque is high in order to hold constant sheet tension. Since horsepower is the product of torque and speed, torque is inversely proportional to speed and the resulting characteristic is constant horsepower.

Likewise, since the torque of a d.c. motor is proportional to the motor field flux and the armature current, then if either of the two is varied, the torque will vary. As the reel builds, the tension tends to increase. This will cause more armature current to circulate in the loop circuit which upsets the regulator in the comparison circuit and causes the field of the center-wind reel motor to be strengthened, thereby slowing it down. Due to the increase in field flux, the torque has been increased, but since the speed has been reduced, the horsepower remains constant. Through all this, the sheet tension remains constant and proportional to armature current. Again, except for friction losses,

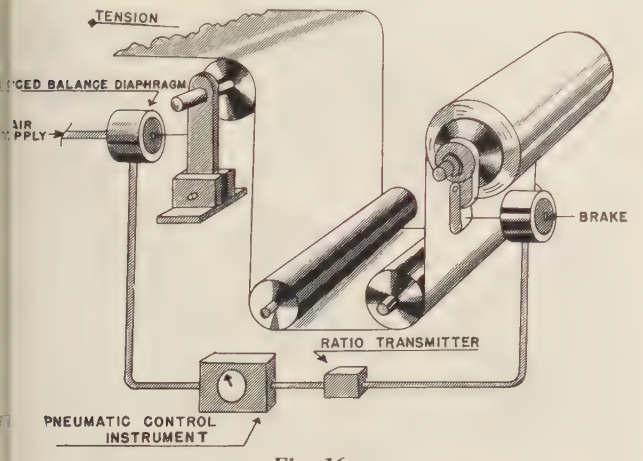

Fig. 16

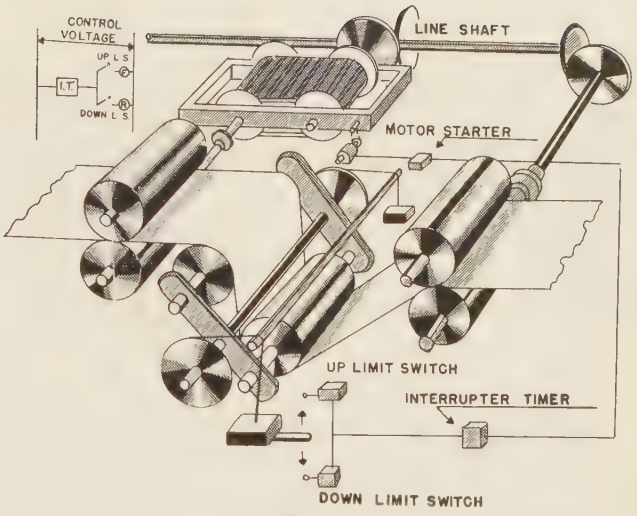

Fig. 17

motor amperes is a measure of sheet tension and this value can be conveniently read on an ammeter.

One of the drawbacks of this system is the range of build-up. Practical design limits the speed range by field control on d.c. motors to 5 to 1, or at most 6 to 1. This means that this type of regulator is limited to a build-up range of, say, 8 to 40 in. or 10 to 50 in. Notice that in both of these examples a large core has been indicated. Small cores such as 3 or 4 in. are not applicable to this type of drive if the final roll size is in excess of 15 to 20 in. After all, the design of a constant horsepower motor is rather awkward. A 5 to 1 motor must have a frame size five times that of an equivalent constant torque motor, or a motor whose speed is adjustable by voltage applied to the armature. This means that if the reel motor requirements are 20 hp., the frame size must be equal to that of a 100-hp. motor. It is economically justified to increase core diameters in order to keep within a build-up range of 5 to 1 since the loss of paper at the core is only a few per cent of the entire reel.

Figure 19 shows how this same regulator can be used on a drum reel application. However, in this case the characteristic is constant torque since the reel motor drives the constant speed reel. Therefore, after the armature current has been measured and compared in the regulator, the output controls the generator field

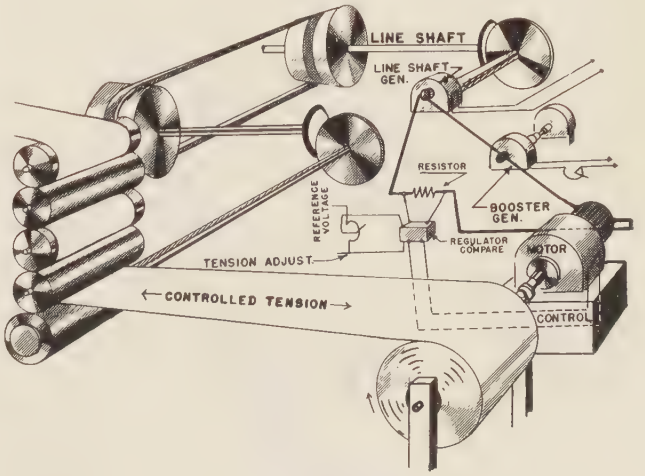

Fig. 18

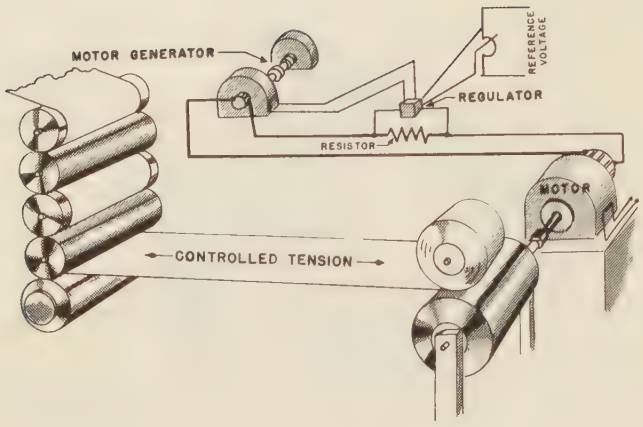

Fig. 19

rather than the motor field. In this case, the field of the motor remains constant and its speed is controlled armature voltage which, in turn, is controlled by the excitation of the generator. Again, it is only necessary to control armature current since torque is proportional to armature current and flux. Holding armature current constant will, in turn, hold tension constant.

Figure 20 shows a rewinder with an unwind stand equipped with a braking generator arranged for constant tension control. The horsepower characteristic is similar to that of a center-wind reel. Instead of controlling a motor, the regulator controls a braking generator.

In this case, the booster generator provides a means of producing tension at standstill in addition to supplying the braking generator loop circuit *IR* drop. The same advantages and limitations apply in the case of braking generators as apply to center-wind reels. There is one additional advantage, however. In the case of wide, high-speed machines, the braking generator may be large enough to return appreciable power to the system.

Figure 21 shows two pairs of rolls where it is desirable to hold sheet tension between them. Both drive motors are connected to a main generator, which establishes the approximate speed of the two motors. However, the field of motor no. 2 is controlled over a very limited range to maintain the position of a dancer roll. The tension of the web is a function of dancer roll weight. The position of the dancer roll may be controlled in a

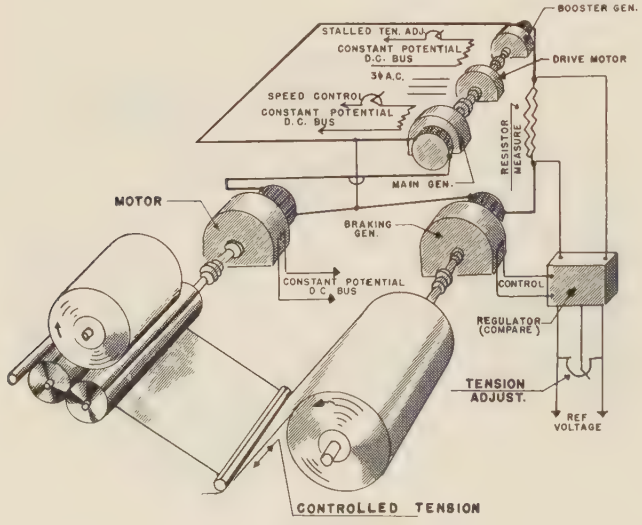

Fig. 20

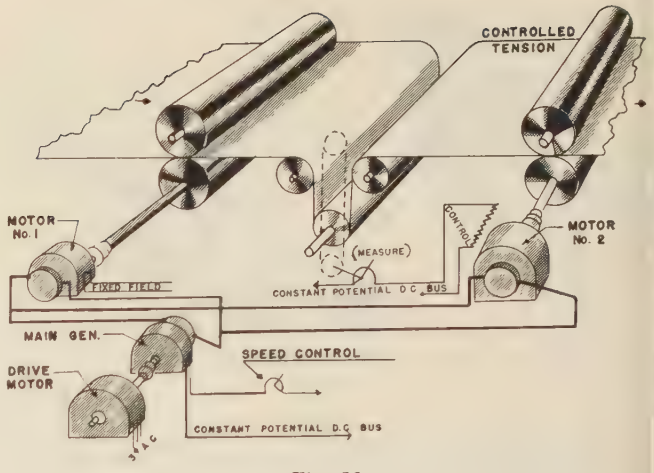

Fig. 21

number of ways. It may turn a wheel that can move a rheostat or a reactor. In the case of the rheostat, as shown in Fig. 21, the change in resistance changes the field strength of motor no. 2, thereby controlling the speed of this motor as a function of dancer roll position.

This system can be applied to center-wind reels, drum reels, and braking generators as shown in Figs. 18, 19, and 20. The only difference is the method of measurement. In this case, the actual sheet tension is established by a roll whose position is measured and compared, whereas in the cases previously described, armature current was shown to be proportional to sheet tension.

Figure 22 shows a control system using a short roll tension indicator for direct measurement of tension. The electrical circuit consists of a reactance bridge feeding into an amplifier for comparison against a reference voltage. The output of the amplifier controls the field of motor no. 2. The mechanical arrangement is quite simple since there is no need for the full width dancer roll.

In addition to its use in the control system described above, the short roll tension indicator can also be applied to override speed control on a sectional drive, where sheet tension rather than speed is to be held between sections. It can also be used to drive a mechanical speed changer similar to that described in Fig. 17. A typical application would be to control a motorized belt shifter on a lineshaft driven paper machine.

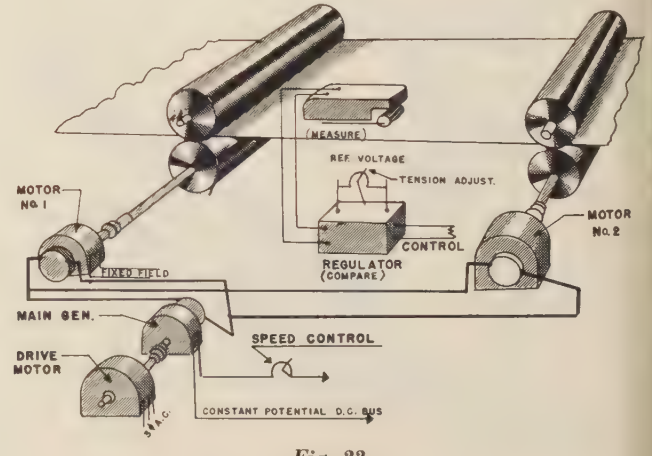

Fig. 22

The short roll tension indicator is applicable to wide range of paper weights.

CONCLUSIONS

After investigating many tension control devices in use or on the market, it becomes apparent that there is a definite pattern to which they conform. As in any feed-back control system, the controlled variable must be measured. There must also be a suitable means of applying corrective action. Between the measurement and the correcting device, there must be a control device of some kind to compare the measurement against a standard and to send out a corrective impulse. Control devices may differ greatly depending upon the measurement, the correcting device, and upon requirements of the system as to accuracy, speed of response, and all the other characteristics of regulating systems in general.

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A Direct Comparison of the Silvering and Permeability Methods of Determining Specific External Surface

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It having been previously determined that the silvering and permeability methods of measuring specific external surface of beaten pulps measure very different surfaces, an experiment was made to compare the two methods directly. The specific surface of some moderately beaten sulphite pulp was determined (1) by the permeability method, (2) by the permeability method after the pulp had been silvered, and (3) by the silvering method (after the pulp had been silvered). The results of (2) and (3) were, roughly speaking, the same and only a fraction of that of (1). It is therefore concluded that the silvering operation, *per se*, reduces the external surface of beaten fibers very considerably. The results were supported by a repetition of the experiment.

The term "surface" is used in this paper to refer to that surface of the fiber which is measured by the particular method under discussion. A discussion of the various surfaces of cellulose is reserved for a later publication, but it may be pointed out that, so far as the development of paper strength is concerned, the surface in which we are interested envelops those parts of a fiber and its component fibrils and microfibrils in a water-wet state which might come into contact and bond with some part of a neighboring fiber. Such a surface is largely that which affects the drainage properties of a pulp and which contributes to the retention of fillers. It is unlikely that any experimental method would be devised which measures precisely this surface; the best that can be hoped for is a reasonable approximation.

The permeability method (*1*) offers promise as a suitable method of measuring this surface, since it is applied to water-wet unmodified fibers. However, preliminary comparative experiments using sulphite wood and esparto grass pulps indicated that while, broadly speaking, the TAPPI silvering (T 226 sm-46) and permeability methods give results in reasonable agreement when the pulps are unbeaten, the values for beaten pulps obtained by the two methods differ greatly; in general terms it may be said that, for a pulp which has been beaten fairly extensively, the fractional increase in specific surface given by the permeability method is an order of magnitude greater than the value obtained by the silvering method. It is clear, in fact, that the two methods measure different surfaces of the beaten pulps. This paper describes an experiment which was carried out to investigate this discrepancy further.

A bleached, Scandinavian softwood sulphite, was beaten for 30 minutes to a wetness of 56° S.-R. in accordance with TAPPI method T 200 m-45. This was divided into three parts, which were tested as follows: (1) unsilvered, by the permeability method; (2) silvered, by the silvering method; and (3) silvered, by the permeability method.

For the specific surface test of sample 2, the TAPPI method as modified by Browning (*2*) was used, the only departures from this being (a) the method of sampling: instead of withdrawing samples by means of a casserole as Browning suggests, samples were run out of a well-stirred aspirator, it having been previously established that, with the particular apparatus in use, no fibers were "hung up" on projecting surfaces to be swept away later as clots, and (b) the use of Bunsen burners to heat the pulp suspension instead of a hot plate.

For the test of sample 3, a large quantity of silvered fibers was required and it was not possible to follow the Browning-TAPPI method closely. In previous experiments with the permeometer, it had been found satisfactory to take about 6 grams of pulp. It was, however, felt likely that about a quarter of this quantity would still give a smooth permeability plot* with an easily recognizable linear section and such, in fact, proved to be the case. Accordingly, 353 ml. of pulp suspension at a consistency of 2.81 grams per liter was silvered as a single volume using quantities of silvering solution appropriate to the quantity of fibers taken. With these alterations, the silvering operation was carried out as advocated by Browning. As a check on sample 3, a further large quantity of fibers was silvered in the same way and designated sample 4.

W. Emerton, Principal Research Officer, R. E. Mattocks, Research Chemist, and D. M. W. Blanchard, Laboratory Assistant. The British Paper and Board Industry Research Association, Kenley, Surrey, England.

* The permeability plot is the graph of a function of permeability and consistency plotted against consistency, from one of the intercepts of which the value of the specific surface is calculated; see (*1*).

Table I

Sample	Date of test	State of fibers	Determination of specific surface Method	Value, m^2/g.
1	Feb. 11	Unsilvered	Permeability	8.37 ± 2.6%
2	Feb. 12	Silvered	Silvering	0.54 ± 18%
3	Feb. 12	Silvered	Permeability	1.15 ± 7.6%
4	Feb. 12	Silvered	Permeability	1.39 ± 1.7%

Pulp beaten Feb. 9 to 56° S.-R. The limits given in the last column are the 95% confidence limits.

It had previously been established that the specific surface can change considerably over the period of a few days; accordingly, steps were taken to obtain all the results in as short a period as possible. The results, which are shown in Table I, are very suggestive, but in view of the departures from the Browning-TAPPI method of silvering the fibers, and because of the considerable significance of these results, it was decided to repeat the experiment. It is thought desirable to describe in detail the silvering of the fibers destined to be tested in the permeometer in this repeat experiment.

A sample of the same bleached sulphite pulp was beaten in accordance with the TAPPI method for 20 min. to a wetness of 44° S.-R. To silver the fibers for the permeometer, the silvering reagent was made up as follows: 250 grams silver nitrate (analytical grade) was dissolved in 1900 ml. of distilled water, and 200 ml. of 0.880 ammonia was added with shaking. Next, dilute ammonia, of about 1 part 0.880 to 10 parts water, was added until there remained only a faint brown precipitate. The solution was refluxed for 2 hr. to remove excess ammonia, and, after cooling, was filtered through glass wool. The volume was then made up to 2500 ml. This solution was used to silver 16 liters of the pulp (consistency 0.164 gram per liter). In a 4-liter conical flask, 2 liters of suspension was raised to boiling point. To the boiling suspension was added 214 ml. of silvering solution. The reaction was allowed to proceed for 15 min., throughout which time the suspension was agitated by means of an air stirrer. The process was repeated until 16 liters of suspension, equivalent to 2.62 grams of fiber, had been silvered. Small portions of the fibers were withdrawn for examination under the microscope and appeared wholly opaque. On completion of the silvering, the fibers were immediately filtered through a sintered glass funnel and washed with water.

The silvering operation and subsequent chemical test of sample 2 was carried out by the Browning-TAPPI method except for the sampling modification referred to above.

All three determinations were carried out on the same day, which was the day following that on which the pulp was beaten. As a check, a further permeability determination on the unsilvered pulp (from the same beating) was carried out 2 days later.

When the results of samples 3 and 4 in Table I (which were obtained by the same method from pulps in the same state) are compared, it should be borne in mind that the pulp for the two samples was silvered in separate operations. This probably accounts for some of the difference between the two values, which difference, however, is not great.

Again, when comparing the results of samples 1 and 4 of Table II, it will be remembered that 2 days elapsed between the two determinations. The comparatively wide confidence limits of sample 4 are due to the fact that only three experimental points were found to lie on the linear section of the permeability plot.

It will be seen that the specific surface value given by the chemical test is in each case rather lower than the values for unbeaten bleached sulphite pulps which have been reported by other workers, e.g., 0.88 (*3*) and 1.34 (*4*), which themselves differ markedly. From the wide spread of these values, it appears that the results may be appreciably influenced by the conditions of the silvering test and that these have not yet been satisfactorily standardized. In particular, it is possible that the duration of the silvering operation is of greater importance than is generally appreciated. Accordingly, it is thought desirable to give here the duration for the five replicates which together made up the sample which was tested by the chemical method: these were 20, 20, 15, 10, and 10 min., respectively, for sample 2 of Table I, and 10 min. in each case for sample 2 of Table II. As mentioned above, the time of silvering sample 3 of this latter table was 15 min. In all cases, the silvering operation was terminated when randomly selected fibers appeared quite opaque under the microscope.

When silvered fibers were placed in the permeability cell and water was run through, a certain cloudiness of the emergent water indicated that some silvered fines were passing through the lower wire screen which supports the pad. The specific surface of these fines will be greater than that of the pad as a whole so that the specific surface of the remaining fibers of the pad would be measured as somewhat lower than the true value. The effect was not thought to be large.

When all these possible sources of error have been considered, however, certain salient facts remain. It is clear that the specific surface of moderately beaten fibers, as measured by the permeometer, is considerably reduced—by a factor of 6 to 8 in these cases—by silvering as closely as possible by the recommended method. Furthermore, the value of the specific surface of silvered fibers as determined by the two test methods is, very roughly, the same. From these results, it is difficult to escape the conclusion that the recommended process of silvering, *per se*, reduces the external surface of beaten fibers almost to the value for unbeaten fibers.

It must be emphasized that this conclusion refers to the method of silvering in bulk which was employed; every effort was made on the occasion of the second part of this experiment to keep this as close as possible to the recommended procedure and it is thought that such departures as were necessary do not preclude extending this conclusion to silvering by the recommended method.

Table II

Sample	Date of test	State of fibers	Determination of specific surface Method	Value, m^2/g.
1	April 28	Unsilvered	Permeability	6.40 ± 3.0%
2	April 28	Silvered	Silvering	0.63 ± 18%
3	April 28	Silvered	Permeability	0.86 ± 1.6%
4	April 30	Unsilvered	Permeability	5.42 ± 13%

Pulp beaten April 27 to 44° S.-R.

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Economics of Handling Mill Supply Chemicals

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Methods and costs of handling mill supply chemicals are discussed from information received from representative mills. Costs are noted as well as operating advantages and disadvantages. Chemicals mostly used by the industry are individually discussed. Included is the method of receipt and handling with percentages of the various methods. Types of storage for the chemicals in use are also given. This is a report of a special subcommittee of the Materials Handling Committee.

For a study such as this, questionnaires were mailed to various pulp and paper mills. While the results of this questionnaire were most gratifying, the number returned was somewhat disappointing. Only 56% of those sent out were returned. The greatest percentage of returns came from the Canadian mills.

The mill supply chemicals studied in this survey are alum, loading (filler) and coating clays, pebble lime, hot lime, limestone, dewatered lime mud, rosin size, salt cake, soda ash, sodium sulphite, starch, sulphur, and titanium dioxide. Methods of handling these chemicals together with the rate of handling and number of men required or used in their handling were received in the survey. Also, types of storages, operating conditions, and dust conditions were also received.

In this report, each chemical will be treated separately since some materials require an entirely different type of handling than others due to differences in physical characteristics. As a basis for costs an average wage rate of the yard gang, which is usually common labor, was assumed at $1.30 per hr. Adding fringe benefits, such as social security, unemployment compensation, insurance plans, etc., a figure of $1.50 per hr. was arrived at. The fork or unloading truck was estimated at $7.50 per day, including maintenance, gasoline, and oil if of the automotive type, and electric current if of the electric type. For a general over-all average on mechanical and pneumatic conveyors, electric current was estimated at 1¢ per kw. Depreciation, original costs of equipment, and housekeeping costs are not included in any of the figures.

Also, not included in the cost figures is the difference between bagged and bulk methods of receiving the chemicals. An average saving of having chemicals shipped in bulk form rather than bags involves a saving of approximately $3.00 per ton. This is the differential on clay, and the other materials should be very much in line with this figure.

Of the questionnaires returned, a total usage of each chemical was tabulated and Fig. 1 shows these totals. Also included in this graph is the number of mills reporting use of the respective chemicals.

ALUM

Alum is received in the mill in any one of three ways: bags, bulk, and liquid. Bag alum is received either by truck or rail; bulk alum by rail, and liquid alum by either tank truck or rail. Mills having an annual consumption of from 10 to 3200 tons report receiving their alum in bags. A majority have these bags palletized and find fork trucks advantageous in their unloading operation. Rates of unloading vary considerably but a good average when unloading bagged alum manually is approximately 1 ton per man-hour. When using palletized bags with fork trucks, the rate is increased to approximately 10 tons per man-hour. This is an average rate and this rate will vary depending upon the distance from the car to the storage area. While different numbers of men were used an average cost would be about $1.50 per ton for manual labor and 20¢ per ton for the fork truck and palletized bags.

Bulk alum is received via rail with mills having an annual consumption of 1000 to 2500 tons reporting. One mill reporting unloads the alum pneumatically at 0.12 man-hour. per ton with a power requirement of 2 kw. per ton or a cost of 20¢ per ton. This same mill reclaims from storage mechanically through a total conveying distance of 50 ft., with a power requirement of 6 kw. per ton and at the rate of 0.25 ton per hr. This operation is done by the mill operator as a regular part of his responsibilities.

Mills having an annual consumption of from 375 to 9600 tons report receiving their alum in liquid form. Most mills report operating advantages and low operating costs. Most liquid alum is received in tank truck, and in most cases the only man required during the unloading operation is the truck driver. Also, the pump is mounted on the truck. This means that no company power is required and little attention from mill personnel is required at any time.

In the storage of liquid alum, a resistant material must be used, e.g., lead, to prevent the deterioration of the storage and handling equipment. Alum contamination, especially by iron, is to be avoided. In concentrated solutions, the temperature must be high enough (approximately 110°F.) to prevent crystallization. The solution is approximately 48% solid. Most storage bins are wood with lead lining. Lead pumps are also used. The mills handling their alum in liquid form remark practically 100%, "a very simple and efficient operation."

CLAY

Clay is received in the mill by either rail, boat, or truck. Of all the clay reportedly received, 95.5% is received by rail. The tabulation in Fig. 2 shows that the majority of the clay received by rail is received in bulk form. Breaking the tonnages down into car loads, it is found that bagged clay amounts to 208 cars and bulk, 3340 cars. This is based on 50-ton cars. The liquid clay amounts to 360 cars based on 70-ton cars.

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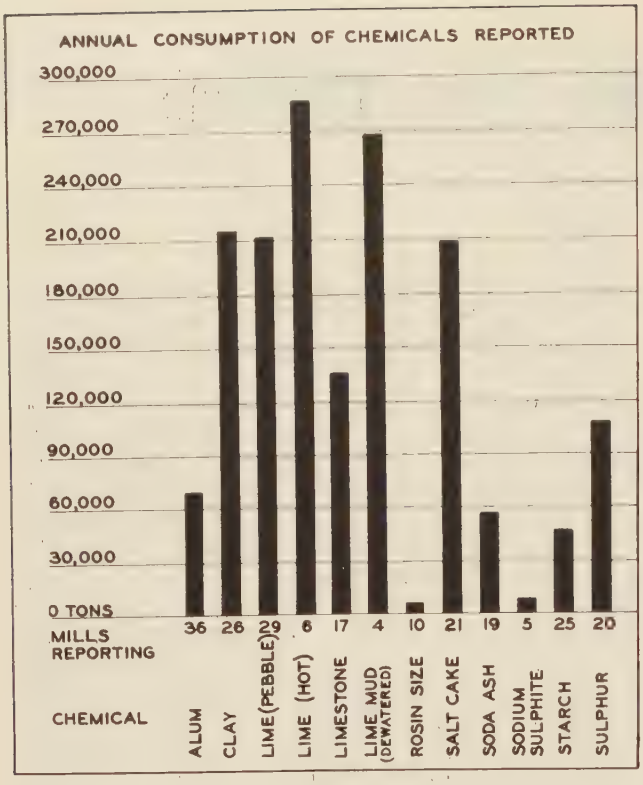

Fig. 1

One mill reported receiving their clay in bulk form by boat, and their particular problem is a special one, and the clay is unloaded by crane into dump trucks.

In the unloading of bagged clay, there are two methods of unloading the car. These are by lift truck and hand truck. For cost in this operation, the cost for unloading a car with the lift truck is 25¢ per ton, and with the hand truck, it is $1.20 per ton. These same trucks handle the clay to storage and in most cases the bags from storage are emptied directly into mixing equipment.

In the unloading of bulk clay, there are three methods in use today: manual, mechanical, and pneumatic. Manual means men with shovels, shovelling into mechanical conveyors for delivery to the storage bins; mechanical is through the use of car scoops dumping into mechanical conveyors for delivery to storage bin, and pneumatic is the unloading by air to the storage bin or if more than one storage bin is used, through pneumatic means to the first bin and mechanical screw conveyors to the other bins. As might be expected, the cost per ton when unloading manually is extremely high. This amounts to $1.65 per ton. The mechanical method of unloading costs 29¢ per ton and the pneumatic method costs 30¢ per ton.

Regarding the types of storage used, it has been found that concrete is the most prevalent, followed by tile and steel bins. In the handling of storage to the mixing tanks, it is found that mechanical conveyors are used mostly, with pneumatic being favored by a few mills. From the information received, it was next to impossible to arrive at a cost per ton rate in handling the clay from storage to the mixing tanks. It is usually the responsibility of the mill operator to reclaim the clay from storage and deliver to the mixing equipment in the proper proportion.

Only one mill reported receiving their clay in liquid form, and this is pumped direct to storage as a slurry, and through a pipe line to a concrete and tile lined steel storage. From this storage, the clay in slurry form is pumped to the use points.

Various remarks were received regarding operating advantages or disadvantages. Mills unloading mechanically report clumsy unloading, bad dust conditions, and spillage. Pneumatic handling was reported as trouble free and economical with moderate dust conditions.

PEBBLE LIME

Of 31 mills reporting, 30 of these mills received their lime by rail and one received their lime by truck. Twenty-six reported receiving the lime in bulk and five in bags. A most surprising fact is that of the three methods of unloading, manual, mechanical, or pneumatic, manual has the highest percentage of the three. Forty-six per cent report manual unloading, 36% mechanical unloading, and 18% pneumatic unloading. The cost when unloading manually has been estimated at $1.20 per ton. When unloading mechanically through payloaders and mechanical conveyors, the estimated cost is 33¢ per ton. When unloading pneumatically, the cost is 34¢ per ton.

When unloading manually and mechanically, it has been found that the majority of conveyors used for handling the lime to storage are screw conveyors and bucket elevators. Storage bins are mainly of two types, steel and concrete.

In the handling of lime from storage, the majority of the mills make excellent use of mechanical conveyors such as screw conveyors and bucket elevators.

Regarding cost in the handling of the lime from storage, it is found that this operation is usually taken care of by regular mill personnel who have other duties to perform. Therefore, these costs are absorbed in general operating.

In the unloading of lime manually and mechanically, most mills using these methods report bad dust conditions. Many operators must wear respirators while

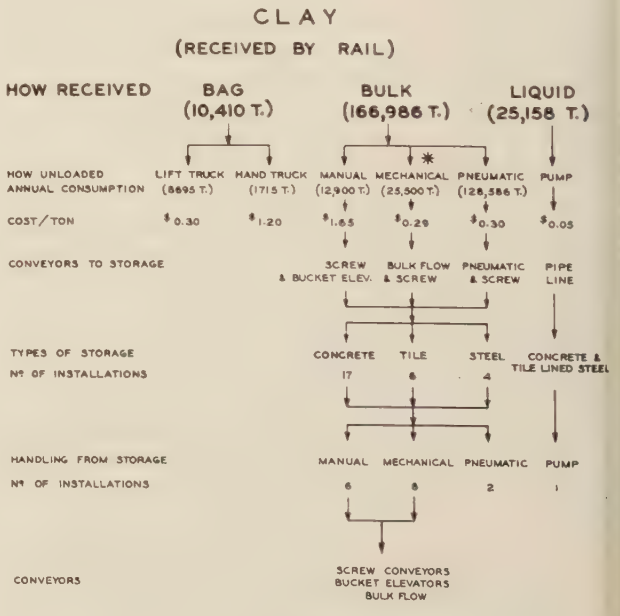

Fig. 2

unloading bulk pebble lime, with some mills employing exhaust fans to eliminate the dust condition. Pneumatic unloaders report excellent dust control with the use of cloth bags to filter the discharge air. Also, that suction unloading from the box car keeps dust at a minimum and reduces the chance of burned skin on the operator of the suction hose.

It appears that there is much room for improvement in many mills in the handling of their pebble lime.

HOT LIME

The conveying of hot lime is an internal plant operation. This operation includes the handling to the storage from the lime kiln and the handling of the lime from storage.

The information received did not include sufficient information to prepare cost figures. For general information, all mills make full use of mechanical conveyors for these operations. In the handling of the hot lime to storage, we find that drag flight conveyors and bucket elevators are mostly used. Steel apron and screw conveyors are also used.

For storage of the hot lime, all of the mills reporting stated that steel bins are used.

For the handling of this lime from storage, again, mechanical conveyors are used exclusively. The feeder itself is of the mechanical type, and the conveyors include screw, bucket elevator, and drag conveyor.

Some mills report bad dust conditions and others report that these conditions are not too serious. In overcoming a bad dust condition, some mills have housed in all conveyors.

LIMESTONE

Of 19 mills reporting, most all of the mills report receiving their limestone in bulk, via rail, with isolated cases of barge and boat delivery. Three mills report receiving via truck.

Unloading of the limestone from rail cars is done both manually and mechanically. From the barge and boat, the unloading is done with cranes. In the unloading of rail cars mechanically, mostly payloaders and cranes with clamshell buckets are used.

As usual, manual unloading is very expensive. The direct labor cost on this type of unloading averages $4.00 per ton. In unloading mechanically via payloaders, long conveying or running distances were involved for the payloaders and the cost per ton is 71¢. The unloading with cranes costs 19¢ per ton considering direct labor only.

Many mills use open storage for limestone and, where bins are used, steel is the choice. From the storage areas to the top of the acid towers, mechanical and manual means are used. Operating disadvantage in the handling of limestone is the heavy labor involved.

LIME MUD (DEWATERED)

In the conveying of lime mud, it is reported that this material is usually conveyed in a slurry form, using pumps and pipe lines. One mill reported pumping this lime mud having a moisture content of 54% and another mill reports pumping through a sludge pump at 35% solids.

In feeding this lime mud to the kiln screw conveyors are used.

Information received was insufficient to prepare any cost figures.

ROSIN SIZE

Rosin size is received at the mill via rail, in either liquid form in tank car, barrels, or pallet boards, and in drums.

In the unloading of tank cars, this is done through pumps and pipe lines with the tank car itself being steam heated using steam from the mill. Usually only one man is required at the car for this operation, and, economically, this method is very successful.

Rosin received in drums and bags is usually unloaded with fork trucks at an average cost of 30¢ to 40¢ per ton.

The usage of rosin size in comparison to other materials is rather small, and it appears that mills having an annual consumption of 1000 tons or more find it economical to purchase their rosin size in liquid form. Most of the mills using up to 400 tons purchase their rosin size either in drums or bags.

SALT CAKE

Salt cake is received in the mill mostly by rail. Of 23 mills reporting, only one receives their salt cake by boat. The tabulation in Fig. 3 is based on the receipt of the salt cake by rail only, with all of this salt cake being received in bulk.

In the unloading of the salt cake, three methods are used: manual, mechanical, and pneumatic. Out of a total of 208,032 tons per year, 36,712 tons are unloaded manually, 110,970 tons mechanically through car scoops, and 60,350 tons pneumatically. From the information received, the cost when unloading manually is $1.20 per ton; mechanically, 32¢ per ton; and pneumatically, 30¢ per ton.

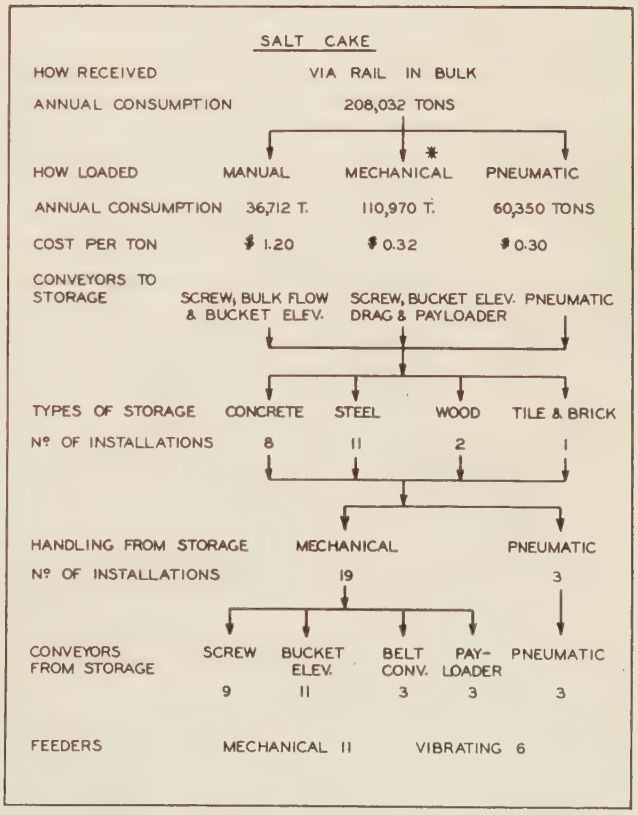

Fig. 3

After the unloading of the salt cake from the car, either manually or mechanically, screw conveyors, bulk flow conveyors, and bucket elevators are used. When pneumatic conveyors are used for unloading, the pneumatic conveyor delivers the material directly to storage.

The types of storage used for salt cake are concrete, steel, wood, and tile and brick combination. Of these types, steel is the most used, and, in most all of the new mills being constructed today, vertical steel storage bins are used.

In the handling of salt cake from storage, mechanical conveyors have been reported as predominant. These consisted of screw conveyors, bucket elevators, and belt conveyors. Three mills reported using payloaders in the handling of their salt cake from storage, and three mills reported using pneumatic conveyors. In feeding salt cake from storage bins, 11 mills reported using mechanical feeders and six mills reported using vibrating feeders.

In the unloading of salt cake either manually or mechanically, many mills report dusty conditions. One mill handling their salt cake pneumatically reports a low cost per ton, with no dust or waste. One mill using open storage reports that the salt cake hardens and another mill reports that the salt cake attacks the cement or concrete construction in the vicinity of the salt cake.

SODA ASH

Soda ash is received in the mill by either rail or truck. It is received both in bulk and in bags. Of the bagged material reported, approximately 50% is palletized and the other 50% is not palletized.

Of the mills receiving their soda ash in bagged form, the maximum annual consumption is 1600 tons. Those receiving their soda ash in bulk vary from 700 ton annual consumption to 16,750.

For costs in unloading bagged materials, it is again found that the cost when unloading with hand trucks is expensive. This amounts to $1.30 per ton and when using fork trucks with palletized bags, the cost per ton ranges in the neighborhood of 40¢ per ton.

In the unloading of soda ash pneumatically, six mills reported an annual consumption of 46,000 tons and it is found that the average horsepower per ton required is 6, and the cost per ton is 32¢. One mill reported receiving their soda ash amounting to 12,000 tons annually by trucks, and unloading pneumatically. These trucks were specially built with special outlets for attachment to the pneumatic conveying system.

One mill having an annual consumption of 4800 tons received their soda ash by rail in hopper bottom cars. These cars were discharged to a mechanical conveying system with this conveying system handling the ash at the rate of 10 tons per hr., and the cost per ton in unloading is 17¢.

In storing bagged soda ash, this is usually placed directly on the floor and in storing bulk soda ash, concrete and steel bins are used.

In the handling of the soda ash from storage to the mixing equipment, bagged soda ash is usually handled manually and of the bulk handlers, 50% use mechanical means and the other 50% use their pneumatic conveyors in conjunction with their unloading equipment.

Mills handling their soda ash in bags report no operating advantages or disadvantages while mills using pneumatic conveyors report labor savings. Only one mill reported bad dust conditions using bagged soda ash and mills using pneumatic systems report only slight dust conditions.

SODIUM SULPHITE

Five mills reported on this material and three of the mills reporting use only minute amounts. Two mills reporting a total annual consumption of 10,000 tons reported receiving their sodium sulphite in bulk and unloading pneumatically.

The cost per ton from the information received is 40¢ and the sulphite is delivered to either concrete or steel storage bins. The handling from storage is done mechanically and no report was made on operating advantages or disadvantages or dust conditions.

STARCH

All mills reporting using starch, receive this material via rail and truck in bagged lots. Usage rates of the mills reporting varied from 13 tons per year to 6300 tons per year.

Most mills manually unload the bagged starch to pallets and then the palletized starch is taken by forked truck to the storage. The distance between the car or truck and the storage area varied and some mills report this distance to be quite considerable. Averaging all of the mills reporting, the cost per ton in unloading their starch is $1.50. This is much higher than other chemicals received by the mills which would indicate farther traveling distances of the forked trucks.

From the remarks received from the mills regarding operating advantages or disadvantages, each individual mill has its specific problems. Some mills report that a palletized unit load lends itself well to their operation for easy, quick handling at low cost. Other mills report expensive bag storage with their operation being slow, expensive, and laborious. Others report that they have reduced their bag damage to a minimum and that they have easy inventory. Also, others report that the distances to and from storage are long. Dust conditions are reported as being at the worst, moderate, and most mills report very slight dust conditions.

SULPHUR

Of 22 mills reporting, 15 receive their sulphur by rail and seven by boat, all in bulk. Mills receiving via rail receive by both box cars and gondola cars. The mills receiving via box cars use payloaders, and those receiving in gondola cars or open top cars use locomotive or other types of cranes. Two mills reported handling the sulphur manually with either wheel scoops or wheelbarrows.

When unloading manually with wheelbarrows, the unloading rate is approximately $1^1/_2$ tons per man-hour. and when unloading by payloader the average rate of the mills reporting is approximately 4 tons per man-hour. When unloading by crane, the average unloading rate is 40 to 45 tons per hr. Lack of operating costs on certain equipment has prevented the comparison in costs of the different methods of unloading.

Most mills report an operating advantage being the proximity of the point of delivery to the storage area.

Many mills reporting use of scoop trucks or payloaders report labor savings together with a minimum amount of dust. However, some mills report water muffler exhausts and sparkproofing on the engines, and bronze blades on the scoop.

In the handling from storage, this has been predominantly reported as manual.

TITANIUM DIOXIDE

All of the titanium dioxide received by the mills is received via rail in bags. Unloading is done by fork trucks and annual consumption of the mills reporting is such that bagged material is the most ideal, since it is usually delivered to the beater room as it is required.

Many other isolated supply chemicals were reported but in no case was enough information received to form any conclusions.

In the study of material handling problems, many factors should be taken into account. Rates of usage and receipt may have a direct bearing on the method to use. Whether or not it is advantageous to receive chemicals in either bagged or bulk form should be given serious consideration. Methods of usage of the chemicals within each mill will determine type of storage and method of handling. Also, any projected improvement should also improve labor relations.

With steadily rising costs, material handling equipment should be such that the materials are handled with a minimum of labor and effort, and if improvements are pending, that the material handling cost be considerably lower.

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Methods for the Determination of Cellulose Chain-Length Distribution

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review is made of methods available for determination f molecular weight distribution in cellulose from the tandpoint of selecting a suitable method for routine etermination.

THE last few years have seen extensive work by ellulose chemists on the determination of average molecular weight or degree of polymerization (D.P.), the morphous-crystalline ratio (accessible/nonaccessible atio) and the molecular weight distribution of cellulose. In the rayon and plastic industries, particularly he former, the importance of all three measurements or technological work is well recognized (*47*, *48*, *26*) nd the American Chemical Society has worked on tandard methods for the determination of average D.P. nd chain-length distribution. In the paper and pulp eld Schur and Lewis (*57*) have reviewed methods of etermining average D.P. of a pulp and pointed out its ractical importance in the manufacture of particular ypes of pulps for specific papers. They state that, For the most uniform behavior of the pulp in the paper ill and for the most uniform quality of paper, the ontrol of the degree of polymerization in the manufacure of most papers of high quality is of extreme importance." The immediate practical utility of a nowledge of the chain-length distribution of a pulp o a papermaker is less certain. Since to date its determination has been laborious and time consuming, is perhaps uncertain as to whether enough determiations have been made in differing enough circumances and on a sufficient number of pulps to allow ny general conclusions to be made. None the less, guing from analogy with the rayon or textile indusies, where Davis (*15*), Scherer and co-workers (*52*, *53*) among others (*11*, *42*, *58*, *66*) have determined molecular weight distribution and pointed out its relationship to such properties as fatigue resistance and tenacity, it seems highly probable that chain-length distribution will be found of importance in pulping and papermaking technology. Indeed, Schur and Lewis, after reviewing some experimental results by Jörgensen, conclude "It would seem as though the way is open to extend our knowledge of the importance of molecular weight distribution on pulp properties through the use of the techniques described by Jörgensen."

Such considerations have led the Chemical Methods Committee of TAPPI to work actively during the last few years upon the cuprammonium and cupriethylenediamine methods for the determination of the average molecular weight of cellulose and to take up consideration of methods for the determination of accessibility and chain-length distribution. In the case of average molecular weight determination in cuprammonium or cupriethylenediamine solution, the situation is now becoming clarified by the work of a number of people, culminating in the recently suggested methods of Martin (*41*) in this country and Wilson (*65*) in Sweden. It appears that after considerable work has been done, some of which has been lost due to the use of faulty techniques (in particular, the nonrecognition of the importance of rate of shear or velocity gradient in the measurement of the viscosity of non-Newtonian fluid (*10*, *66*), a satisfactory method is about to be adopted long after the importance of measurement in relation to the strength properties of paper pulp has been recognized. It is the hope of the Chemical Methods Committee that an adequate method for the determination of molecular weight distribution can be developed without such a time lag.

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The determination of chain-length distribution of cellulose, or indeed of any high polymer (*17*), unless carried out from ultracentrifuge data, consists essentially of two steps: (1) The separation of the original cellulose sample into a series of fractions of graded and as nearly uniform as possible molecular weight, and (2) the determination of the average molecular weight of each fraction.

THE FRACTIONATION OF CELLULOSE

The only practical method of splitting the cellulose sample into portions of approximately similar molecular weight is to dissolve it or a derivative, which must be prepared from the cellulose without degradation, in a suitable inert solvent. Successive fractions are then precipitated by the use of a nonsolvent, added in stages, or by stepwise changes of temperature, fractional extraction of the cellulose by liquids of increasing solvent power has been found unsatisfactory (*29*), due to difficulty in reaching a true equilibrium by this method.

Early attempts at fractionation were made using cellulose itself dissolved in cupriethylenediamine or some other solvent. Such early work, reviewed up to 1945 by Cragg and Hammerschlag (*13*), suffered from the fact that all cellulose solvents produced some degradation, either of themselves or by atmospheric oxidation. However, it has been shown (*14, 59*) that cellulose can be nitrated without serious degradation, and the resulting trinitrate, rather than the original cellulose, can be dissolved in a suitable solvent and fractionated. The nitration technique has the further advantage that cellulose treated with urea-formaldehyde or melamine-formaldehyde resins, while difficultly soluble or insoluble in cuprammonium, may readily have its fluidity as cellulose nitrate in acetone determined (*6*).

Nitration conditions have been investigated by Nicolas (*45*), who measured the viscosities in butylacetate of cellulose nitrates prepared from a series of nitrating mixtures. A mixture consisting of 48% nitric acid, 2% phosphorous pentoxide, and 50% phosphoric acid was found to give the highest viscosity with presumably least degradation. The nitration technique has also been investigated by others, including Alexander and Mitchell (*1*) and Shockley at The Institute of Paper Chemistry (*28*). Shockley standardized on 52.3% nitric acid, 9.7% phosphorous pentoxide, and 39% phosphoric acid. Nitration is carried out at 25°C., a large excess of acid (50 ml. for 0.5 gram material) being used. Exposures of up to 5 hr. result in no degradation (*28*).

The nitrate produced must be filtered from the excess nitrating acid, carefully avoiding drawing air through it while acid is still present, in order to avoid degradation. It is then thoroughly washed with a large volume of ice water and is ready for stabilization. Here again degradation must be avoided; boiling with distilled water for 3 hr. (*15*), and stirring vigorously for 15 min. with 2% sodium carbonate (*28*) are two of numerous methods used. After stabilization, the nitrate must again be washed thoroughly, first with water, then with alcohol, and after drying at 40°C. is ready for fractionation.

A satisfactory nitrate, when analyzed by the nitrometer method (*20*), shows 13.2 to 13.9% nitrogen and the phosphorous content is not greater than 0.02 to 0.04%, corresponding to about 1 to 2 phosphate groups per 800 glucose residues (*15*). Such a nitrate, either kept wet under ethyl alcohol, or in solution in acetone, has been demonstrated by Davis (*15*) to be remarkably stable, unlike the nitrates prepared by Herrent and Govaerts (*22*), who stated that degradation occurred rapidly on standing. Some doubt perhaps still exists as to whether or not a properly prepared nitrate shows a decrease in viscosity upon standing in acetone (or other organic solvents). Campbell and Johnson (*7*) have even suggested that the first rapid viscosity decrease can be attributed to breakage of hydrogen bonds between adjacent polymer molecules, the further slow decline in viscosity being due to cleavage of glycosidic linkages in the chain. However, the results of Davis already referred to, and of de Wind and Hermans (*19*) seem to make such speculations unnecessary.

For fractionation the cellulose nitrate is dissolved as a 1.5 to 2% solution and fractionally precipitated. Perhaps the most usual procedure, (see, e.g., (*15, 53, 58, 66*)), is to precipitate from a dilute acetone solution by addition of a hydrocarbon (ligroin or hexane), using the technique of increasing the temperature to redissolve all the precipitate, followed by cooling slowly to the original temperature while stirring. The fractions are thus precipitated as viscous liquids and should be in complete equilibrium with the solution. The first fractions precipitated are again dissolved in acetone and hexane and fractionally precipitated until 20 to 40 fractions are obtained. The range of molecular weights within each fraction should not extend beyond the average molecular weight of the two adjacent fractions. Water has also been used as the nonsolvent or precipitant (*28, 44*), followed by centrifuging of the precipitates to separate them and after a number of fractions have been obtained, evaporation of the mixture to obtain several more fractions. The fractions obtained with either procedure must be weighed.

Scherer and Lou (*51*) have investigated the effect of degree of nitration, from 10.97 to 13.55% nitrogen content, on the fractionation of the nitrate, concluding that fractionation is possible at any nitrogen content if solvent composition is adjusted.

Because of the long and tedious work involved in the fractional precipitation, efforts have been made to shorten it. Oth (*46*) adapted the turbidimetric method used earlier on cellulose acetate butyrates (*43*), finding that the fractional precipitation of the nitrate from acetone by methanol containing 10% water can be followed quantitatively by turbidimetric measurements alone. Brooks and Badger (*4, 5*) have suggested interesting possibilities for shortening the fractionation procedure. The more promising is elution chromatography making use of the different adsorptive capacities of starch for cellulose nitrates of different molecular weights.

THE DETERMINATION OF MOLECULAR WEIGHT

Determination of the molecular weight of the cellulose nitrate fractions conceivably could be carried out by any one of a number of methods, osmotic pressure, ultracentrifugal techniques, sedimentation equilibrium or velocity, light scattering, viscosity, etc., the theoretical basis of which, together with determinations made on a variety of macromolecules up to 1946, has been reviewed by Johnson (*34*) and up to 1952 by Schulz (*54*).

Of the methods available, only two, osmotic pressure and viscosity determination in a suitable solvent, are sufficiently rapid and easy to conduct, to have been used extensively for cellulose nitrate or other cellulose derivatives (*15, 31, 22, 23, 27, 28, 30, 36, 44, 45, 50, 58, 64, 66, 67*). The osmotic pressure method is probably the most reliable method for the determination of molecular weight (number average), the experimental techniques employed having been improved steadily during recent years (*2, 31, 34, 61*). None the less, it remains a more cumbersome experimental method and more limited in its range, (D.P. 150 to 1500) than the measurement of intrinsic viscosity, for which it has been used most frequently as the primary calibration standard (*15, 30, 50, 56*). Fortunately, the measurement of intrinsic velocity, $[\eta]$, is relatively straightforward and the relation:

$$[\eta] = KM^{\alpha} \qquad (1)$$

where K and α are constants for any particular system (α assuming values between 0.60 and 1.00), is generally accepted. For cellulose and its derivatives α is apparently very close to unity, although Munster (*44*) has found that $\alpha = 1$ only for D.P.s below 600, decreasing as D.P. increases above 600. While other experimental evidence is lacking (*30, 56, 63*), some theoretical support is given by Kuhn and Kuhn (*37*) who deduce that at low molecular weights the viscosity is proportional to the square of the chain length, at intermediate D.P. to the chain length itself (Staudinger equation valid), and at high D.P. to the square root of the chain length. Mark (*40*) has also looked into the theoretical background of the Staudinger equation, concluding that above a D.P. of about 1000 complications arise from the movement of the solvent through, as well as around, the solute molecules. It appears to be an open question as to the limits of D.P. within which the value of α can be taken as unity and a single value of K can be used in the Staudinger equation. The intrinsic viscosity can be obtained by measuring the specific viscosity, η_{sp}, where

$$\eta_{sp} = \frac{\eta - \eta_0}{\eta_0} \qquad (2)$$

and η_0 is the viscosity of the solvent, η that of the solution, at a number of concentrations with subsequent extrapolation to zero concentration

$$[\eta] = \lim_{c \to 0} \eta_{sp}/c \qquad (3)$$

Intrinsic viscosities can also be determined by the use of Huggin's equation (*32, 55*):

$$[\eta] = (\eta_{sp}/c)/(1 + K_1 \eta_{sp}) \qquad (4)$$

where K_1 is a constant characteristic of a given solute-solvent system, or by the Martin equation (*41*)

$$\log \eta_{sp}/c = \log [\eta] + K_2 [\eta]c \qquad (5)$$

where K_2 also is a constant specific for the solute-solvent system.

Huggins (*33*) and others have pointed out that in using osmotic measurements to calibrate the viscosity method, i.e., to determine K and α, the osmotic pressure must be obtained by extrapolation to infinite dilution and that a number-average molecular weight method (osmotic pressure) is being used to calibrate a weight-average method. This is permissible only if the distribution of chain lengths is substantially the same in the samples used for calibration and in all the unknown samples whose average molecular weight is desired. This means that, in the examination of any given series of cellulose fractions for polymolecularity by the viscosity method, the samples must be homogeneous as far as chain length is concerned, or values of the Staudinger constant must be determined on a limited number of the fractions.

Recently (*30*) it has been suggested that the constants in the Staudinger equation may vary with the nature and pretreatment of the cellulose before its conversion into the derivative and also with the degree of the substitution of the latter. The actual value of the Staudinger constant, K, for nitrocellulose solutions appears to be in some doubt (Table I). Perhaps the main cause of variation is failure to make proper allowance for the nitrogen content of the sample used. Wannow (*62*) found K to vary from 9.7×10^{-3} for a commercial rayon nitrated to a 10.7% nitrogen content to 17.7×10^{-3} for the same rayon nitrated to 13.79% nitrogen. While his results have been criticized on the grounds that he used unfractionated material, thus in effect comparing number-average and weight-average measures of D.P., Lindsley and Frank (*39*) have confirmed the effect experimentally. They found that the intrinsic viscosity at 12% nitrogen is only about 50% that of the trinitrate prepared from the same cellulose sample. The effect is much too large to be ignored but can be corrected for as long as the nitrocellulose contains more than 11.5% nitrogen (*39*). It has also been suggested (*3, 30, 44*) that the constants in the Staudinger equation vary with the nature and pretreatment of the cellulose before its conversion into the nitrate or other derivative.

This uncertainty in the value of the constants of equation (1), while a serious drawback when absolute values of molecular weight or D.P. are desired, need not interfere too seriously in comparative work. In fact it may be best to adhere to values of intrinsic viscosity until more reliable data on the constants are available.

In the case of cellulose acetates, Cox and Battista (*12*) recently have overcome some of the uncertainties in the value of K, as affected by degree of substitution, by simultaneous solution and deacetylation in cuprammonium hydroxide. Whether or not such a pro-

Table I. Values of Constant in the Staudinger Equation
Uncorrected for nitrogen content

Type of cellulose	*Treatment*	$K \times 10^3$, *dl./gram*	*Reference*
Cotton	Hydrolysis with 0.5 *M* $KHSO_4$	8.4	*56*
Cotton	Oxidation	10.2	*56*
Cotton	Bleached	10.2	*64*
Cotton	Hydrolysis with 0.5 *M* $KHSO_4$	9.6	*30*
Spruce pulp (Mitscherlich)	Hydrolysis with 0.5 *M* $KHSO_4$	11.6	*30*
Aspen pulp (semichemical)	Hydrolysis with 0.5 *M* $KHSO_4$	11.6	*30*
Pulps and cotton		8.7	*57*
Cotton	Hydrolysis	10.6	*35*
Sulphate wood pulp		12.7	*35*
Sulphite wood pulp		10.6	*35*
Smokeless powder		9.4	*3*
Miscellaneous	Miscellaneous	10.5	*45*
Literature survey		12	*39*

cedure could be used for other cellulose derivatives is uncertain.

The measurement of relative viscosity is usually done with concentrations of 0.1 to 1 gram of nitrate per 100 grams of solution. Four or five concentrations are measured to permit the calculation of intrinsic viscosity. The Ostwald, Ubbelohde, or the pipete-filling viscometer of Cannon and Fenske (*8*) are suitable, the last fitted with a small, detachable, sintered-glass filter (*24*) appears to be particularly useful. For details of the techniques used, articles such as those of de Wind and Hermans (*18*), Davis and Elliott (*16*), Heuser and Jörgensen (*28*), etc., may be consulted. Appropriate kinetic energy corrections must be made. Unfortunately no means has been found for correcting for anomalous flow effects or non-Newtonian behavior of high polymer solutions. It would seem desirable for the most accurate work that the intrinsic viscosity be determined at a series of velocity gradients, and, if found to be dependent to a marked degree upon this factor, that determinations should be made at a chosen velocity gradient. Certainly this effect, dependence of viscosity and hence intrinsic viscosity upon rate of shear, must be borne in mind, although it is believed that a standardized method in which the effects of velocity gradient are minimized can be devised by some technique such as that suggested by Martin (*41*) for aqueous cellulose solutions. de Wind and Hermans (*19*) have measured the viscosity of 0.05 to 0.8% nitrocellulose in acetone solutions over a wide range of velocity gradients and conclude that non-Newtonian flow is absent at infinite dilution, suggesting that by extrapolation to infinite dilution this confusing factor can be avoided. Lindsley (*38*) has also investigated the effect of rate of shear upon viscosity and concludes it to be important only for high D.P. nitrocelluloses. Even with these, extrapolation over the concentration range where reduced viscosity ($\eta sp/c$) is linear with concentration makes any correction or special method of determination unimportant.

The selection of the solvent for viscosity determination must also be considered. Acetone has been most commonly employed, although ethyl acetate (*1*), butyl acetate (*45*) and a mixture of 77.5% *n*-butyl lactate and 22.5% diacetone alcohol by weight (*16*) have also found use. The low volatility of the last solvent together with its high viscosity allows very precise determinations of specific viscosity at low concentrations, without the need of a viscometer of small capillary radius. The same intrinsic viscosity was obtained as in acetone and the standard error of the measurements was halved.

CONCLUSIONS

Consideration of the points raised indicates that any standard method for chain-length distribution will have to be highly specific in its directions to the technician. Decisions will have to be made as to:

1. Degree of substitution.
2. Method of preparation, isolation, and stabilization of the nitrate.
3. Composition of fractionation solvent and precipitant.
4. Method of fractionation, i.e., temperature, agitation, etc., and separation of fractions.
5. Solvent for intrinsic viscosity determination.
6. Velocity gradient at which viscosity determination is made or provision for making this variable negligible.
7. Expression of results by selection of suitable values for the Staudinger equation constants.

The American Chemical Society (Cellulose Division) has suggested a tentative procedure which covers most of the above points. It is hoped over the next year to check this as a first step by the Chemical Methods Committee, keeping in mind the salient facts mentioned in this review.

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Fire Protection in Pulp and Paper Mills

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Subject matter includes factors that tend to bring about a higher degree of fire safety in pulp and paper mills with an aim toward building up defenses to attain the status of a fire-safe plant. Topics of discussion include building construction, sprinkler protection, special hazard protection, paper mill occupancy protection, and particularly danger points in production processes from a fire and explosion standpoint, protection of pulpwood yards, potential electrical fire hazards and safeguards, importance and extent of employee fire brigade organization and typical fires together with a word on the elimination of fire causes and salvage possibilities. Summation and conclusion point out the importance of full cooperation of management, supervision, and labor personnel in developing and maintaining a fire safety attitude at a high level.

The organization of a fire prevention and fire protection program for pulp and paper mills may be aptly defined as the arrangement into an effective and efficient working whole of all the elements which are essential for the prevention of fire and the protection against fire. Because of the constant danger of loss by fire and other associated perils, a realistic approach must be made to provide and maintain fire-safe conditions at all times. While a 100% "fire-immune" plant is an unattainable status, it is quite possible to achieve a relatively high degree of fire safety in most any plant if favorable conditions are present. This degree of fire safety is generally in almost direct proportion to the quality of the construction of the mill, the application of fire protection equipment, personnel fire safety organization and training, and other equally important factors and components which are subsequently touched on in the following discussion.

Paper and pulp mills have been, in many cases over the years, dependent upon their own resources to a great extent for establishing their defenses against fire because of their geographic locations near rivers and woods outside of town. In the larger mills, this condition had brought about a need for self-sufficiency in developing an all-around fire protection program, including an employee fire brigade organization because of their physical size and isolated location. Due to the comparatively low cost and easy availability of timber, many of the original paper mills were largely constructed of wood, and there are still many large mill properties that have some of their older buildings of all wood contruction. In the realization that less vulnerable kind of contruction was necessary to retard the ravages of fire, steady improvements were made during the evolution of industrial construction which brought into being masonry mill-type buildings, and finally noncombustible and fire-resistive structures. Likewise, the importance of adequate automatic sprinkler protection was acknowledged and as fire-safety standards and good practice recommendations based on various kinds of experience were developed, the more progressive and safety conscious mills promptly took advantage of these advances to make their plants better and safer places to work in.

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BUILDING CONSTRUCTION

Brief mention was just made of the evolutionary processes in paper and pulp mill construction with a foreword on the full concept of the principles of fire safety. A pre-eminent factor in a fire-safe plant is its type of construction since this is the starting point in developing any mill fire protection program. Numerous factors must be considered when comparing various buildings on the basis of their safety from loss by fire. When an attempt is made to evaluate a building for a particular kind of mill occupancy, investigations should be made as to type of construction, height, size of areas subject to fire, exposure and fire protection, as well as appearance, cost, and ability to resist all elements, including fire. With these factors considered, a decision can be made to build one of five general types of buildings: fire-resistive, noncombustible, heavy timber (mill and semi-mill), ordinary masonry joist, and wood frame. The first three types are most desirable in the construction of paper mill buildings and, on the other end of the scale, wood frame structures should be avoided wherever possible. A popular type of present-day multistory building in the paper industry is one having fire-resistive and/or substantial noncombustible construction throughout except for a heavy wood plank roof which is believed to have a longer life and can be better maintained where moist and corrosive atmospheric conditions prevail.

Where building stability in the face of intense internal fire exposure is an important factor in a building, a structure of high fire resistance should be considered, such as reinforced concrete or protected steel construction. In this connection, it is interesting to note that an unprotected steel column with a cross-sectional area of 8 sq. in. has an estimated useful fire-resistance period of only 10 min., however, if this column is protected with 1 in. of coarse aggregate concrete, the fire resistance can be increased to 1 hr. Mill and semi-mill type buildings having heavy wood beam and post supporting members are highly resistant to collapse under severe fire exposure, even with deep charring.

Good fire resistive and incombustible construction has meant increased mill fire safety and along with good construction the building should be properly subdivided into fire areas by fire walls and yard spaces, hazardous processes segregated, and openings between floors should be protected to prevent the rapid spread of fire from one story to another. Important manufacturing occupancies should be segregated from storage areas and it is considered safe practice in large paper mills having several fourdrinier-type paper machines to segregate the machines with fire barrier walls to avoid the possibility of having several or all machines exposed to a devastating fire in a single unbroken fire area.

In addition to segregation of mill areas by fire walls and concrete floors, other features are incorporated into the design of a building to restrict the spread of fire, such as ceiling draft curtains where single unbroken areas are abnormally large, adequate enclosures or curtains around stairs, elevators, conveyor openings, etc., to prevent or retard the vertical travel of fire and heat, water curtains and hooded sprinkler protection and exposure protection against nearby neighboring property, such as blank walls, wired glass in metal sash windows, fire shutters, and open sprinklers.

Structural deficiencies usually present in older mill buildings, principally in wood structures, which are detrimental to good fire protection are concealed low spaces, ceiling and attic spaces, and hollow walls and boxed cornices where combustible materials are used. The application of noncombustible fire stops, bulkheads, and insulation has a deterrent effect on fire involving combustible concealed spaces. Some few older minor buildings and sheds have wood shingles which are susceptible to flying brands and sparks and once ignited, burn stubbornly and rapidly. Many older mill buildings with wood roofs have inadequate anchorage and wide overhanging eaves making them vulnerable to extensive windstorm damage.

The vital importance of maintaining constant vigilance in preventing fires during building construction periods cannot be too lightly stressed. During such times the permanent protection equipment is not in service and, therefore, reasonable care should be exercised in keeping combustibles to a minimum, absolute cleanliness should be practiced, flameproofed tarpaulins used, and safeguards taken to prevent fires from salamanders and cutting and welding sparks. If new building is to be sprinklered, this equipment should be installed and placed in service as promptly as conditions permit and before the building area becomes occupied and important values accumulate.

FIRE PROTECTION EQUIPMENT APPLICATIONS

Pulp and paper mill properties without sprinkler protection are few and far between, although incomplete protection is prevalent in many mills. Automatic sprinkers are considered as the main line of fire defense and it should be said that when the first automatic sprinklers made their appearance in American industry in 1875, some of the original installers soon thereafter, along with with textile mills, were pulp and paper mills.

The value of sprinkler equipment was recognized as a very definite benefit in the protection of these early mills. The feasibility of installing these first sprinkler systems was enhanced by the fact that a ready supply of water was virtually always available at paper mills. As improvements were made in sprinkler system devices and installations became more complete throughout a mill property, it became a matter of fact that large fires were seldom noted in protected mills and that nine out of ten average fires were snuffed out or checked by sprinkler action. On the other hand, unsprinklered mills remained vulnerable to destructive fires where the possibilities of damage were unlimited. Over the years sprinklers have prevented countless fires in American industry (92% of recorded fires in sprinklered areas have been extinguished or checked with 25 sprinklers or less) and many times they've meant the difference between a few minutes' interruption and a costly shutdown.

The real effectiveness of automatic sprinklers lies in the fact that they always stand on "guard," ready to go into action whenever fire starts and they strike at the seat of the fire undeterred by heat or smoke. Sprinklers are likened to firemen stationed at approximately every 100 sq. ft. of mill area, always poised to detect the outbreak of fire and then go to work to extinguish the blaze and also send out an alarm for assistance.

It is important in the installation of sprinkler equipment that sprinklers be installed in every area of the mill having either combustible materials in its construction or a combustible occupancy. This means that sprinklers should also go into concealed spaces, closets, enclosures, etc., wherever there is anything that can burn. Combustible areas lacking sprinkler protection place sprinklers in adjacent protected areas at a decided disadvantage in that sprinklers away from the fire can become fused and add to the water loss and even deplete or weaken the water supplies if an excessive number of heads open.

A good sprinklered mill is one that is equipped with a complete and well-maintained sprinkler system covering throughout all combustible areas with modern or modernized equipment, devices, and pipe sizes meeting with present-day standards. Good sprinkler systems should have strong and reliable water supplies behind them, such as connections from a good public water system, fire pumps with ample suction supply, and adequately sized and properly elevated gravity tanks. Depending upon the size of the mill and the extent of the sprinkler protection pattern, combinations of various water supply sources are used to strengthen the water pressure and volume and increase the reliability. In paper mills adjacent to rivers, head races and flumes generally make satisfactory suction supply for fire pumps and are used extensively throughout the country. The undesirable feature of using river water for mill fire protection systems is due to the unpure nature of this water which

makes it difficult and even prohibitive to permanently interconnect such unpotable water supply to a fire main system using public water because of danger of contamination to the clean water supply. River water also brings about the need for more frequent flushing of piping to rid the system of possible obstructions result-

Fire in outside storage jumbo rolls paper

ng from presence of sedimentation and foreign naterials. In most sizable mills, a separate mill use or omestic water system is provided to take care of proc- ss water and sanitation water, and in many cases con- titutes a dependable water supply which can be used or plant fire protection water systems thus availing hemselves of the otherwise independent mill water ystem to reinforce and supplement the standard fire ystem water supplies.

A new type of sprinkler head, known as the spray prinkler, has been developed by the sprinkler manu- acturing industry in the past few years and earlier this ear, the National Fire Protection Association adopted ew standards for the installation of automatic spray prinkler systems for ordinary hazard occupancies. his new type head provides an increase of 20 to 30% ore area coverage per sprinkler than the conventional ype. Almost all of the sprinkler installations being ade today are being made with spray sprinklers. he proponents of spray sprinkler protection con- dently anticipate increased efficiency of sprinkler pro- ction because of the greater heat absorbency proper- es of the spray discharge and, consequently, less perating sprinklers and less water being discharged for given fire as compared to regular sprinklers.

A distinguishing feature of the new spray sprinkler is at all of the water is discharged directly onto the fire the floor since the deflectors are so designed to divert e water in all directions below the plane of the flector. Little or no water is discharged onto the iling as contrasted to the conventional sprinkler which designed to discharge approximately 60% of the ater directly against the ceiling. The spray sprinkler ttern is roughly that of a half sphere completely filled th water spray which covers a circular area at a stance of 4 ft. below the deflector with a diameter of ft. even when discharging at only 15 g.p.m. The ea covered is greater at distances over 4 ft. and is less with a lesser clearance and, like regular sprinklers, the area covered increases with increased pressure and discharge rate. We look forward to seeing many new spray sprinkler installations going into pulp and paper mills and quite likely many existing installations of regular sprinklers will be changed over to the new spray head where required and where conditions permit.

In addition to mill sprinkler protection, other types of extinguishing mediums are employed to cope with special hazards that arise from the use of flammable liquids, gases, and dusts in connection with industrial processes and methods. Carbon dioxide gas, foam, water fog, steam, and dry chemical powder on fixed pipe systems and actuated by rate-of-temperature rise or fixed temperature release devices all have their specific applications for special fire hazards and generally are used to supplement and augment automatic sprinkler protection.

It should be borne in mind that the best fire protective system can be made useless by poor maintenance and the finest sprinkler equipment can be rendered ineffective if there is a closed gate valve or partial sprinkler protection. A mill fire system should be constantly maintained in good working order ready to go into instant action when fire strikes. A good inspection program by competent plant men is necessary to guarantee a full measure of preparedness, and should complement the periodical inspections of fire insurance company engineers. The annual testing of sprinkler equipment, water supplies, and other fire protection appurtenances by fire insurance engineers is a highly valued service in determining the operating condition and adequacy of this vital protection equipment.

SPECIAL OCCUPANCY PROTECTION

The paper and pulp industry has extreme diversification covering the full range of its activities. Aside from paper conversion plants, the basic type mills from a production standpoint include sulphite, sulphate, semi-chemical, groundwood, rag, old paper, straw (and kindred stock) pulp producing mills from whose stock the various kinds of paper are developed. For the most part, the occupancies and manufacturing processes of this class of industrial plants fall in the ordinary fire hazard classification. Generally speaking there are very few occupancies in the average pulp and paper mill that should be without automatic sprinkler protection principally owing to the combustible nature of the raw materials and product. There are, however, specific danger points from the standpoint of fire and explosion in certain production processes that should be recognized and adequate safeguards applied. In a specific mill there usually are several areas falling in the special hazard category in various degrees of severity. For the sake of generalization and because of the wide knowledge and use of these processes in the industry as a whole, emphasis will be placed on what is considered as being good fire protection practice regarding chip bins; sulphur handling; paper dust removal; stock storage problems, including the special problems of wastepaper and rolled paper storage; paper machine hood protection; boiler combustion safeguards; and coating and printing processes employing flammable liquids.

The protection of elevated chip bins in sulphite and sulphate mills is a matter of prime concern. Because

of the large amount of wood chips which are poured into the average bin, the highest potential B.t.u. heat concentration in the mill is located here. A deep-seated fire in a chip bin is always difficult to extinguish because of elevation difficulties, depth of chips, together with generation of extreme heat and smoke. Some kinds of chips under certain conditions have a tendency to produce spontaneous combustion and traces of gases of fermentation. All chip bins should be fully sprinkler protected under strong water pressure augmented with hose lines on vertical standpipes. Because of the necessity of employing a large volume of water to cope with an extensive chip bin fire, it sometimes is advisable to install an additional open sprinkler piping layout under manual control paralleling or straddling automatic sprinkler equipment to reinforce and provide additional water for fire-fighting. Many chip bins have steam agitation facilities to dislodge chips and make them freeflowing into the digesters below; this steam, provided it is saturated and not superheated, can be used to advantage in combating chip fires.

Chip bins preferably should be of incombustible construction. Virtually all newly constructed chip bins are of fire resistive construction and many of the older heavy wood constructed bins are lined with a noncombustible sheathing. Individual chip bins should not be excessive in capacity and the various individual bins should be segregated from each other by unbroken masonry walls to prevent fire from communicating from bin to bin. An aid in the rapid elimination of chips involved in a bin fire would be an adequate sized hatch opening at bottom of bin which could be quickly opened to transfer chips to a safe outside location. New semichemical pulp mills constructed in recent years have outside ground supported chip bin tanks of steel construction with hatches at bottom for expelling chips onto ground in case of fire and other emergencies.

The handling of sulphur in the manufacture of sulphuric acid for chemical pulp making must necessarily be done with care because of the explosive character of this material in dust form. Numerous violent sulphur dust explosions of destructive force have been recorded in the pulp industry. Sulphur used at the average mill consists of lumps of various sizes with dust of various fineness. No unusual hazard is present while sulphur is in dead storage; the explosive danger looms when sulphur is being moved as in conveying and dumping sulphur from a railroad car to an inside storage enclosure. In the explosibility ratings of the United States Department of Argiculture where combustible dusts of a uniform fineness have been tabulated in 11 groups with ratings of 0 (no explosion produced or of very low order) to 10 (maxium explosive effect) sulphur has a rating of 7. In these ratings, alkali starch and pure cellulose with a rating of 10 were most explosive in the composite test, however, sulphur is placed in the same category with powdered cork and dusts of certain woods, bituminous coal, rubber, rice starch, tapioca flour, etc.

Practically all combustible materials when finely divided and suspended in the air in proper concentration can be ignited to produce an explosion or at least a flash fire, and the finer the dust the greater the explosibility. In addition to sulphur dust, other common dusts present in pulp and paper mills are wood dust, rosins, starches, and paper dust. The fundamentals of dust explosion prevention which are practiced in various degrees of effectiveness in high-grade mills in those areas where combustible dusts are handled or accumulate, include the following considerations: dust-tight enclosures for handling equipment to avoid the release of dust into the atmosphere, cleaning up dust deposits by mechanical or portable equipment, avoiding sources of ignition, using Underwriters' Laboratories' approved dust-tight electrical equipment, and providing positive grounds on moving equipment to dissipate static electricity. With sulphur, which is ground and transferred by screw or belt conveyor, it may be necessary to install pneumatic or magnetic separators to remove spark-producing foreign material and "chokes" to stop propagation of possible explosion. Sulphur storage rooms should be of noncombustible construction with a minimum of ledges which collect dust, and explosion venting windows or hatches should be provided in the ratio of 1 sq. ft. of vent area to each 50 to 80 cu. ft. of room volume to avoid structural damage in case of explosion. Vents are also needed for enclosed processing equipment and dust collectors.

The removal of paper dust from dust producing operations in paper mills offers a constant challenge, especially in mills running tissue paper. In most cases it has been quite successfully coped with by means of good maintenance and housekeeping methods and mechanical dust removal equipment. As a rule, the amount of paper dust liberated in the various types of paper mills ranges from tissue class paper of short fiber texture downward to heavy kraft, board, and rag stock paper. Forced suction mechanical dust collecting equipment should be provided if necessary at winders, rewinders, calenders, trimmers, and automatic packaging machinery to capture dust at chief points of emanation and prevent its rapid accumulation on building members. Suction systems with water wash or spray facilities or filtering equipment have proved to be quite efficient in arresting picked-up paper dust.

Hoods over fourdrinier and Yankee-type paper machine drier rolls are today mostly of asbestos board on steel frame construction, although there are some machines with wooden hoods. Since the primary function of a hood is to keep the machine ventilated and to rid the machine atmosphere of excess moisture and heat, there is a steady movement of air-borne paper dust and loose fiber which comes off the paper sheet. This combustible dust and linter adheres to the surface of the hood, particularly at the dry end, in varying accumulations depending on several factors such as kind of paper being run and frequency of clean-up schedule and speed of machine. This condition, plus the fact that a considerable amount of burnable fuel is present on a paper machine such as the running paper sheet, drier felts, paper dust, and fragments which collect on machine frame and members, lubricating system for bearings, and broke pit under the machine, has brought about the realization that an expensive and important paper machine cannot be without essential fire protection. In the case of fourdrinier machine hoods, an approved system of automatic sprinklers covering the hood proper, vent ducts, broke pit under the machine, and economizer equipment (where provided) having proper high degree rated heads and strategic control valves has definitely proved itself to be the best fire protection

that can be applied to a paper machine. In innumerable instances of fire breaking out under a sprinklered machine hood, a few discharging sprinklers have extinguished or checked the fire with relatively little material loss and machine downtime as compared to the considerably larger loss potential with an unsprinklered hood. There is still a small minority of mill managers who are quite reluctant to install sprinklers under fourdrinier machine hoods for various unfounded reasons, the principal one being the fear of wetting the steam-heated drier rolls. There is no established evidence of a drier roll being damaged by sprinkler water discharging onto a fire involving a paper machine, but on the contrary, sprinklers have held down incipient fires which otherwise would have turned out to be extensive and even highly destructive. The importance of hood sprinklers is amplified on high-speed machines and on older machines which have been rebuilt to gain more speed by adding such features as antifriction bearings and pressure fed oiling from an automatic recirculating system. The appearance of the newly developed spray sprinkler with its discharge of finely divided water particles promises to offer even more effective automatic protection to fourdrinier machine hoods than the conventional regular sprinkler installation and should soon overcome the hesitancy manifested in that minority of mills which still tolerate unsprinklered hoods.

The general practice in mills having Yankee paper machines with large single drier rolls carrying high steam pressure (approximately 100 p.s.i.) is to omit sprinkler protection from under hoods. Such hoods are not nearly as large as fourdrinier hoods and manual extinguishing equipment can be used effectively. Nonetheless, there are some mills where they are not satisfied with anything less than automatic sprinkler protection under Yankee hoods. Saturated steam jets strategically located in the hood and vent duct and operated under manual control, which are primarily used to blow down the paper dust deposits on the inside surfaces, can also be capably employed to combat fire involving the hood.

A large portion of the average mill is given over to storage or warehouse occupancies for raw stock, semi-finished, and finished goods. Material in storage should conform to good practice regulations insofar as fire protection, maximum floor loadings, width of aisles, separation of individual piles, limitation on pile sizes and heights, etc., are concerned. Storage floors should be well drained and stock susceptible to water damage should be skidded at least 4 in. off floors, especially in areas below grade level. Some special considerations affect certain types of paper mill storage, for instance, pulp, wastepaper, jumbo paper rolls, and oxidizing material.

As a general rule automatic sprinkler protection is not required in fully noncombustible or fire-resistive building areas containing pulp in storage which has a moisture content in excess of 60% by weight and the area is otherwise devoid of combustible storage. Baled wastepaper presents a storage problem calling for rather stringent regulations because of its conglomerate physical nature and the loose paper hazard with accompanying untidy conditions. Good storage requirements embody basic standards confining wastepaper to one-story incombustible or fire-resistive buildings under full sprinkler protection with well-drained floors in which a maximum of about 1000 tons is restricted to a single fire area. The largest single pile should not exceed 250 tons with a height limit of 12 ft. and with aisles between individual piles not less than 10 ft. in width and 5 ft. clear space between piles and walls. Outside yard storage of wastepaper should also adhere to safe fire protection practices relative to size of piles and adequate exposure clearances.

Jumbo rolls of paper within buildings should always be stored in sprinklered areas. There has been a tendency in some mills and paper warehouses to oppose the installation of sprinklers in rolled paper storage areas, particularly with kraft rolls and other heavy paper, because of a mistaken belief that tight rolls cannot be readily damaged by fire. Fire statistics and a high loss experience disprove this impression; within the past year alone there have been several extensive fires involving rolled paper and a few which ended up in multimillion dollar losses. Areas occupied for rolled paper of any kind should be sprinklered, cut off from paper machine rooms and other important manufacturing areas, high piling avoided, paper litter removed, and dog ears taken off and loose ends securely sealed. Jumbo rolls stored in outside yards should be kept at least 50 ft. away from plant buildings, maximum height of 12 ft. respected, aisle space of 25 ft. between piles provided, and sources of ignition eliminated from storage areas.

Many mills with bleaching operations use oxidizing chemicals such as hydrogen peroxide, sodium peroxide, sodium nitrate, and chlorine dioxide. This material should be kept in isolated locations away from combustible or readily oxidizable stocks. While these chemicals are not combustible in themselves, they will liberate considerable oxygen if combustibles within close proximity become involved in fire thereby intensifying the fire.

Large boiler plant installations are a component part of paper and pulp mill operations, furnishing both process heat and building heat. Various kinds of fuel are burned, including coal, bark, hogged wood, fuel oil, and gas and sometimes in combination with each other. Pulverized coal systems can be subject to explosions or fire within the conveyor and pulverizing mill equipment and the necessary safeguards should be incorporated to minimize possibility of damage. Preventing fuel explosions in gas and oil-fired boilers is a matter which should receive prime attention. The larger the boiler the larger the probable explosion damage. With the trend to much larger automatic lighted boilers, the need for approved combustion safeguards will be increased. The most common type of combustion safeguard or flame failure supervisory device is the electronically sensitive photoelectric eye or flamerod.

From all accounts, notable advances have been made in the design of black liquor recovery boilers used in sulphate mill operations for salvaging sodium salts. This type boiler probably presents the most important hazard in the sulphate process of pulp making since it is a matter of record that explosions are possible on any black liquor recovery boiler. This fact alone would justify the need for combustion safeguards of either the photoelectric or radiant heat-actuated type which could actuate an audible or visible alarm or even be in-

terconnected eventually to a manual opening electric safety shut-off valve to cut off fuel supply in event of flame failure in the fire box. In some new installations, the molten "smelt" from the recovery boiler flows through a continuous water spray into the chemical recovery tank or steam shatter jets are provided in

Pulpwood fire showing importance of channel barriers

smelt spout hoods which minimize the possibility of steam explosions in the recovery tank.

Coating and printing processes in connection with papermaking introduce a starching hazard and flammable liquid hazard that require special treatment. For the most part the use of starch in paper mills is limited to relatively small quantities in coating and surface calender sizing usually where ventilation is good or where negative pressures are applied. Rotogravure printing presses and aniline ink presses use inks that are quick drying produced by volatile flammable solvents which present a severe fire and explosion hazard both in their handling and mixing and use on the press. In addition to the provision of adequate exhaust ventilation systems on these machines, explosionproof electrical equipment, room sprinkler protection, humidification control, and static electricity eliminators should be afforded, also automatic carbon dioxide gas is desirable for protection of open type ink fountains and high valued machines. The best type of special fire extinguishing equipment for asphalt coating or impregnating machines for waterproofing papers is automatic water spray or water fog protection for hot asphalt tank and freshly coated paper in which an "anti-boilover" ingredient is added to spray system through a proportioning arrangement to prevent asphalt boilovers and steam explosions resulting from discharge of fire extinguishment water.

PROTECTION OF PULPWOOD YARDS

All wood pulp manufacturing mills have sizable inventories in yards adjacent to and extending out from mill properties. In many mills of large producing capacity, several months' to a year's log supply is kept on hand with highest amount generally built up during log harvesting periods. The prevention of fire in log piles is of foremost concern to mill operators and in the most fire-conscious mills a high degree of fire protection is applied in log yards and ranges downward to those mills which have taken an indifferent attitude toward good protection practices. Many present-day standards for pulpwood storage and fire protection stem from the respect gained from the largest and most costly fire in the history of the industry which struck a Canadian mill in 1932. It burned for 12 days and was not finally extinguished until 180,000 cords out of a total pile of 219,000 cords had been consumed. Limiting the size of individual piles should be the first fire-safety consideration. Methods of storing logs fall into three descriptions: high tumbled piles, ranked storage, and low tumbled piles. Good piling standards call for a minimum clear space of at least 100 ft. between individual piles and mill buildings. Current good practice for *high tumbled piles* limit maximum storage to 20,000 cords and height to 70 ft. in single piles with a clear distance of 100 ft. between individual piles; for *ranked storage* individual piles should be not over 2500 cords with piles separated up to a distance of 50 ft. between piles (in the case of maximum 45 ft. high piles) and no group of piles to be in excess of 10,000 cords with space up to 150 ft. between groups (in the case of maximum 45 ft. high piles); with *low tumbled piles* which result from crane handling, individual piles are held to 35 to 40 ft. high with base width of 125 to 150 ft. and aisles separating individual piles are usually 35 to 50 ft. wide.

Large volumes of water must be used to cope with an extensive or deeply burrowed fire in log piles. In the case of medium to large size log yards with maximum size piling, fire main systems with hydrants 300 ft. apart and water requirements ranging upward to 3500 g.p.m. at 100 lb. pressure would be in order, and in some instances a minimum of 5000 g.p.m. would be required. Elevated monitor nozzles are desirable where piles are in excess of 25 ft. in height. Many other precautions and safety measures must be exercised to round out a

Fighting pulpwood fire from channel area

protection program for log yards such as wetting of piles in warm weather; elimination of weeds; prohibition of smoking; maintaining all-weather roadways; placing spark arresters on stacks of coal locomotives; distribution of casks, pails, and extinguishers; maintaining hourly recorded watch service during in-

operative periods; and keeping intact a well-trained fire brigade organization.

ELECTRICAL PROTECTION

Fire statistics indicate that more mill fires start from electrical causes than from any other cause. Mill electrical equipment is generally well designed and properly installed but any trouble generally arises from inadequate subsequent maintenance. A good maintenance schedule will help to eliminate most electrical causes. This schedule should include a frequent check-up of motors as to proper working order, control equipment, condition of wiring, fuses, transformers, and lightning arresters.

Virtually all large mills generate their own electrical power either in whole or part by means of steam turbo-generators or hydro-generators. In view of the value of this equipment from a production continuity standpoint, expecially where insufficient power is available from the public utility, the importance of special protection on generating equipment can be appreciated. In enclosed turbo-generators, permanently piped carbon dioxide is the preferred protection but where it is not practical to provide this protection on generators of 3000 kva. capacity or over, manually controlled perforated water spray pipes should be provided on both ends. Alternating current turbo-generators larger than 1000 kva. should be protected with fast acting differential relays, or reverse energy relays where deemed necessary.

EMPLOYEE FIRE BRIGADE ORGANIZATION

A good fire record in many a mill is due to an effective organization of employees for fire safety. Two mills may be equally well protected physically yet the one with an employee organization for fire safety will have superior chances of avoiding serious fire. Private fire brigades are maintained in practically all medium and large sized paper and pulp mills, the effectiveness of the brigades being based on various factors such as training, fire-fighting equipment provided, frequency of drills, leadership, etc. Mills outside the boundaries of public fire protection should, and in most instances do, have well-developed fire brigade organizations because of their self-sufficient nature relative to all matters pertaining to fire safety.

All mills, however small, should have some type of fire brigade organization drilled and trained in the use of extinguishers and having a familiarity with operation of automatic sprinklers. Trained men on the scene, such as machine hands at a paper machine, can, when fire strikes, nearly always bring the blaze quickly under control thereby saving damage and disruption to production. Mills with their own hydrant and hose systems need well-trained men to put this equipment into use promptly when needed.

Mill fire brigades should be made up of key employees from the various departments to be augmented by maintenance men and headed by a competent fire chief. In large mills which cover much ground, it is usually necessary to have a full time fire chief who has full charge of the brigade organization and also looks after the maintenance of all fire-fighting equipment. Mobile apparatus with pumping facilities is highly desirable in large properties with extensive yard storage.

One of the most important duties of the mill brigade organization from the fire chief down to key members is to institute and maintain a good plant inspection and fire equipment maintenance program at a high level. Any equipment not in proper working order brings about a sense of "false security." A regular check-up should be made to see that the sprinkler system is in full working order, fire doors operate properly, extinguishers are fully charged, and hazardous conditions are reported and corrected. A report form should be filled out after every inspection.

Watchman service is vital to plant safety. Mills of any size and value should maintain good watch service consisting of recorded hourly rounds covering the entire premises during inoperative periods. Watchmen should be intelligent, alert, and physically capable. They should have a good knowledge of the mill fire protection equipment and should know what to do in case of emergencies.

MISCELLANEOUS PAPER AND PULP MILL FIRE ITEMS

Fires have struck all classes of mills in the pulp and paper industry over the years and although decided improvements have been made in mill fire protection, the fast tempo of plant production schedules, together with the introduction of hazardous operations and processes, have continued to cause a high fire frequency with some fires reaching considerable proportions. The most appalling fire loss in American industry today is being caused by cutting and welding operations on emergency repair jobs, etc. Cutting and welding should be conducted under safe conditions under competent supervision under the rigid control of a good permit system.

Of a total of 1854 reported fires in the pulp and paper industry catalogued by the National Fire Protection Association for a fire record basis, it was found that 45% were caused by common hazards such as misuse of electricity, smoking and matches, heating defects, cutting and welding, etc., 37% were caused by special hazards such as overheated bearings in processing equipment, frictional sparks on belts, etc., ignition of waste and dusts, etc, during processing, and numerous other causes, and 18% of the fires were of unknown origin. Of 25 reported sulphur dust explosions, the principal causes were given as due to static electricity sparks, frictional heat, and foreign material in handling equipment.

Many causes of fires can be eliminated by practicing good housekeeping, applying proper safeguards, keeping up good maintenance procedures, and developing a fire consciousness at all plant levels. It should be borne in mind that good working conditions and better production go hand-in-hand with greater fire safety when a mill is kept clean, orderly, and uncrowded.

As fires are extinguished, much can be done to reduce a loss to damaged goods by quick salvage operations. Stocks vulnerable to water damage should be skidded off floors, water should be removed from floors during and right after fire-fighting operations, and tarpaulins should be used to cover contents and machinery on floors below the scene of fire-fighting activities. Wettened goods should be dried out as promptly as possible to prevent further deterioration. Certain material like wastepaper is highly susceptible to both fire and water

damage and has a low salvageability. Rolled paper also has low salvage if subjected to moderate to high fire and water damage, even though water penetration into the roll is of moderate depth.

MANAGEMENT, SUPERVISION, AND LABOR PERSONNEL COOPERATION

In modern successful and progressive mills, good fire records are not due to "accident" where an interest in fire prevention pervades the entire organization from management down through the supervisory personnel to the employees themselves. Those people given the responsibility for planning and coordinating fire prevention and protection must secure the cooperation of employees, teach them to recognize fire hazards, and establish definite regulations as needed. A burned plant cannot produce, therefore, all people on the payroll have a definite obligation to do their part in keeping their plant safe from fire to insure the continuity of their pay checks. A burned-out mill is an economic loss to the entire community.

Careful planning with due consideration to and appreciation of the fire safety features in connection with changes in plant or process, and particularly when new hazards are introduced, will go a long way toward assuring a full measure of safety. Cooperation of outside agencies, such as the underwriting fire insurance company and proper legal authorities, should be consulted whenever plans affecting plant fire safety are concerned.

CONCLUSION

In concluding this paper, it should be said that it is the intent of this treatise to point out, and explain where necessary, the principal facets and highlights of a general fire protection pattern affecting a cross section of the pulp and paper industry. Every mill should constantly aim to build up and improve its fire defenses. Quite logically, the degree to which a mill is able to incorporate all of the component basic principles of good fire protection practice will determine the relative extent of potential fire frequency and severity.

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The Mechanical Properties of Paper—Part II

GEOFFREY BROUGHTON and JAMES P. WANG

Further work on the Instron tensile tester using papers immersed in a variety of organic liquids and water is reported. The shape of the stress-strain curve and work to rupture are related to the hydrogen bonding power of the liquid.

In Part I of this series (*1*) load-elongation curves for a number of typical papers were measured at constant rates of elongation, varying from 0.02 to 2 in. per min., using the Instron tensile tester. It was found that, while tensile strength, elongation at break, and energy absorption capacity were functions of the rate of elongation employed, the stress-strain curves showed no marked differences in shape as elongation rate was increased and that the maximum change in tensile strength observed in any series was only 20% for a hundredfold variation in elongation rate. For this reason it was decided justifiable to continue the investigation using only one elongation rate, 0.1 in. per min. All results reported in this paper were obtained using this rate.

During recent years much information on the molecular structure of high polymers, textile fibers, etc. has been obtained by a thorough study of their load-elongation diagrams including loading-unloading cycles, which throw valuable light upon their elastic behavior. For example, Harris, Mizell, and Fourt (*13*) were able to demonstrate the importance of cross linking on the stress-strain diagram of wool, showing that a wool fiber freed from cross linking by chemical treatment was distinctly weaker and more elastic than the original. Conversely, conclusions as to the occurrence of cross-linking, hydrogen bonding, etc. have been drawn from stress-strain diagrams (*8, 10, 19*). Considering the generalized stress-strain diagram of a typical high polymer (Fig. 1a) it now appears to be agreed that the portion AB (absent for many materials) is due to morphological effects, e.g., crimp in wool; BC represents the breaking of intermolecular bonds (a dense molecular network with many cross links leading to a higher tensile strength and lower elongation than a more open network with few cross links); and the final portion CD the orientation and slippage of the macromolecules, now free to move with lowered resistance. Figure 1b indicates the changes which occur when the stress is released before breakage occurs and, after returning to zero, is again increased. At the point E so many bonds have been broken that instead of returning along EB, a number of bonds are immediately reformed in new geometrical positions where linkage can occur, a rapid drop in stress occurs, and EF is the path followed as strain is reduced. FA represents the permanent stretch or secondary creep. On again deforming the specimen, this time to break, the path FG is traveled. Summarizing, it may be expected that many cross links will lead to high initial modulus of elasticity and comparatively high tensile strength. The area of the loop EF will also be large. Few cross links and little attraction between the chains tend to give a low modulus, highly extensible material of lower tensile strength. This shows less permanent stretch and a smaller hysteresis loop EF than the more highly linked material.

Although the paper sheet is incomparably more complicated in its structure than any simple fiber, it seems not unlikely that some information can be obtained by study of its stress-strain behavior, regarding it as a "giant macromolecule," whose strength lies to a large

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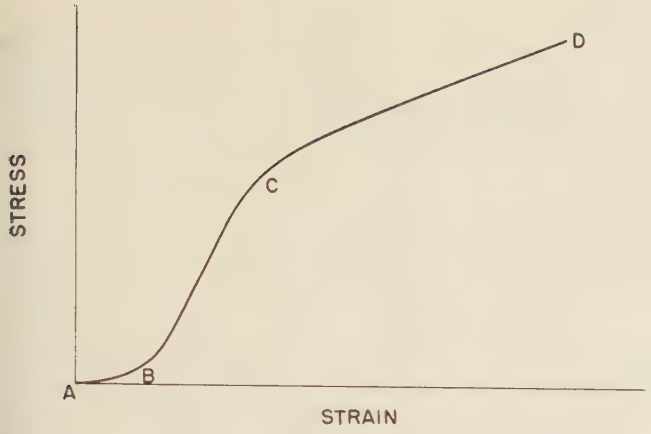

Fig. 1a

degree in fiber-to-fiber bonds. Here the fibers may be regarded as taking the place of the molecular chains of the ordinary polymer. The fibers, varying greatly in length, are alike in that all, except the shortest, must lie in the plane of the sheet. All are likely to be curved in degrees varying from a sharp kinking to a gentle ellipse. They may vary greatly in fibrillation but each must be in contact or close to contact with many other fibers. Further, if the sheet has been made on the paper machine, the fibers are not oriented at random (*6*). It is well established (*22*) that the actually observed strength of paper is less than that of the individual fibers from which it is made, being probably only of the order of 10 to 15% of the latter. For this reason it seems likely that the shape of the stress-strain curve will be dictated by the number and character of the links between the individual fibers, just as the stress-strain curve of a rubber or plastic depends upon the bonds between the molecules. Adhesion at the points of contact between fibers could conceivably be due to mechanical action, polar attractive forces, hydrogen bridging, or chemical bonding by primary valence forces. Mechanical friction between the interwoven fibers and fibrils appears to be discounted, not only by the reversibility of the paper stress-strain curve once secondary creep has been removed, but by the low strength of a paper sheet formed from a well-beaten pulp in which the water has been displaced after beating by a nonpolar liquid (to be described in Part III of this series). Mechanical entanglement would appear to require no difference in stress-strain properties irrespective of the solvent from which the sheet was formed. Polar bonds and hydrogen bridges both belong to the category of secondary valence forces, the former being visualized as caused by the attraction of positively and negatively charged groups, the latter by the ability of a hydrogen atom to link electronegative elements of small atomic radius (*15*). Both types of bonds are susceptible to rupture by water and other polar liquids and both have lower dissociation energies than primary valence bonds. However, it has been estimated that polar bond attractive forces, such as might occur between carboxyl and hydroxyl groups in the cellulose chains, are not large, energy value of the order of 2000 calories per mole, and that they fall off rapidly with distance becoming negligible at more than 4 A units. Hydrogen bridges, —OH...O—, while having higher energy values of the order of 5000 to 7000 calories per mole, are effective over still smaller

Table I. Cycling Test Procedure

1.	Extend the strip 0.04 in. (2% of initial length) at 0.1 in. per min. and retract at same rate to zero load.
2.	Repeat operation 1.
3.	Repeat operation 1.
4.	Immediately re-extend the strip at 0.1 in. per min. to rupture.

distances approximating 2 to 3 A units. Primary chemical bonds possess considerably higher energies, 30,000 calories per mole or more, and are believed to have little part in paper structure, except in special cases where ether linkages between two contiguous hydroxyl groups may be formed. Such chemical bonds would be expected to confer on the paper sheet high resistance to polar solvents, high strength, and possible brittleness.

Support for bonding in the paper sheet being due to secondary valence forces acting between fibers and fibrillae is also given by the contraction and increase in density which occur during its formation. As Campbell (*4*) has pointed out, capillarity causes large forces to be brought into play during drying, which insures the fiber-to-fiber distance being of the order required for formation of polar or hydrogen bonds. Furthermore, beating might be expected to cause greater bonding by allowing more intimate contact between cellulose surfaces or, alternatively, pressure during sheet formation might create interfibrary distances satisfactory for bonding. This was confirmed by Doughty (*9*), who showed that sheets made from unbeaten pulp, under pressures high enough to give a sheet of density equal to that made from beaten stock, were practically as strong as those made from the beaten pulp.

Providing paper strength is primarily developed as suggested through secondary valence forces acting between the fibers it seems not unlikely that useful information could be obtained by a careful study of stress-strain curves of paper immersed in water and liquids of varying polarity. Some support for this is found in the work of Nayer and Hossfeld (*20*), who found that the swelling of maple wood in organic liquids was directly related to hydrogen bond formation as evidenced by plotting degrees of swelling against values of liquid polarity measured by infrared hydroxyl-frequency displacement (*11, 12*). Kress and Bialkowsky (*16*) had earlier measured the swelling of cellulose in a number of organic liquids, finding that cellulose did not beat readily in those liquids causing little swelling. Other investigators, e.g., Cottrall (*5*), have noted the effect of liquids

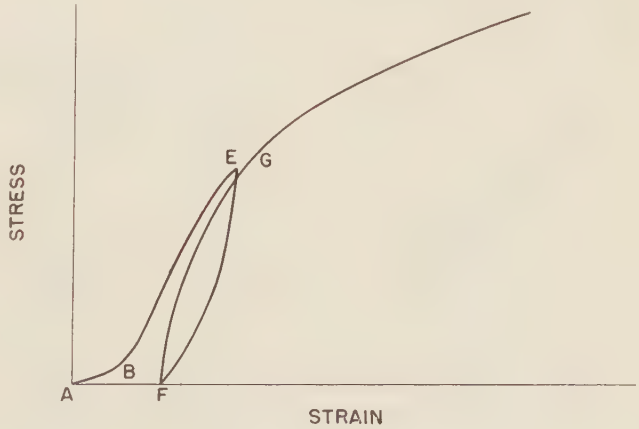

Fig. 1b

Table II. Liquids Used with Their Physical Properties

Liquid	Viscosity, cp. (25°C.), η	Surface tension, dyne/cm. (20°), σ	Dipole moment debye, μ	Dielectric constant (low frequency), E	Energy density, α	μ^2/E	$(E-1)^{1/2}$	Infrared hydroxyl frequency displacement, $\Delta\mu$
Water	0.9	72.0	1.84	79.6	23.41	0.04	8.9	..
Glycerol	5000	63.1	..	14	13.20	..	3.6	..
Methyl alcohol	0.6	22.6	1.65	31.2	14.80	0.08	5.5	..
Ethyl alcohol	1.1	21.3	1.7	25.8	12.80	0.11	5.0	..
n-Butyl alcohol	2.5	26.2	1.7	18	11.10	0.16	4.1	..
Butyl cellosolve	.....	..	2.08	...	...	..	..	..
Aniline	3.8	42.9	1.55	7.25	10.00	0.24	2.5	0.27
Diethyl ether	0.22	17.0	1.15	4.3	7.70	0.30	1.82	0.19
Dioxane	1.1	35.4	0.4	2.2	10.15	0.07	1.10	0.14
Acetone	0.3	23.1	2.85	21.3	9.89	0.38	4.5	0.14
Toluene	0.55	30.2	0.4	2.39	8.94	0.07	1.14	..
Benzene	0.6	28.9	0.00	2.28	9.21	0.00	1.13	0
Nitrobenzene	2.0	43.9	3.9	35.7	9.58	0.42	5.9	0.04
Carbon tetrachloride	0.95	26.7	0.00	2.1	8.62	0.00	1.05	..

other than water on the physical properties of the paper sheet, nonpolar liquids incapable of affecting the fiber-to-fiber bonds having little or no effect upon the strength whereas polar liquids substantially eliminated the bonding between the fibers. Experiments have therefore been made which included (1) a survey of the effect of a number of liquids on the stress-strain behavior of a waterleaf sulphite paper, (2) a more detailed study of the effect of four of these liquids, water, ethyl alcohol, butyl alcohol, and toluene upon the stress-strain behavior of a sulphite paper containing a small amount of melamine-formaldehyde wet-strength resin, thus making the curves somewhat easier to run, and (3) a study of the effect of water upon the stress-strain curves of the papers used in Part I of this series.

EXPERIMENTAL

All data presented in this paper were obtained on the Instron tensile testing machine, which has been described elsewhere (*3*, *14*). Conditions were maintained at 65 ± 5% R.H. and 70 ± 2°F. for testing the dry specimens. Specimens broken wet with liquid were presoaked in the liquid for at least 12 hr. and after insertion between the Instron jaws kept saturated with liquid delivered from a pipet. Samples were cut by razor blade to $^3/_8$ in. wide and 2 in. in length. Ten strips were broken in all cases except in the general survey when five were used; all jaw breaks were discarded. Chart magnifications were 10× or 100×; in the more detailed work with the limited group of liquids chart magnification was 100× or 200×. In the second group of experiments cycling was carried out, the procedure being shown in Table I.

The liquids used, together with some pertinent physical properties, are shown in Table II. They were of a technical C.P. grade. Properties of some of the papers used are given in Table I of Part I (*2*). The waterleaf sulphite and sulphite papers used had basis weights of 10 and 16 lb. per 1000 sq. ft. and calipers of 4.8 and 6 thousandths of an inch, respectively.

From each stress-strain curve three values were obtained directly: the breaking strength in pounds, the elongation at break in inches, and the energy absorption capacity to break in inch-pounds. The first two are read directly from the chart, the third is obtained by an automatic integrator, attached directly to the Instron, which integrates the area under the curve as it is traced by the pen.

These data were not corrected to cross-sectional area at break or for solid fraction, as was done in Part I. An exception was made for the papers of Part I, broken when wet with water, where cross comparison with the earlier results appeared desirable. No corrections were made for two reasons. First, the nonuniformity innate in a paper sheet is accentuated when the sheet is wet. This is reflected in the standard error of the means. Second, only one paper was used in each series and the values obtained for tensile strength, elongation, and energy absorption could be compared with one another and the wet with dry, leading to a semiquantitative interpretation where it was hoped that differences in order of magnitude and sequence could be correlated with polarity of the liquid. The corrections would have been of no value for this purpose.

Where cycling was employed in the second series (Table I), the force required to produce 2% elongation

Table III. Curve Characteristics in Various Liquids

Liquid	Breaking strength: Average, lb./in.	Breaking strength: Standard deviation	Elongation at break: Average, %	Elongation at break: Standard deviation	Energy absorption capacity: Average, in.-lb.	Energy absorption capacity: Standard deviation
Dry	10.48	1.07	2.15	0.15	0.122	0.025
Water	0.51	0.06	1.60	0.15	0.0063	0.0004
Glycerol	1.33	0.17	2.20	0.10	0.0220	0.0024
Methyl alcohol	2.57	0.55	1.60	0.10	0.0200	0.0054
Butyl alcohol	7.51	0.50	1.80	0.05	0.067	0.016
Butyl cellosolve	3.77	0.58	1.45	0.10	0.034	0.005
Aniline	4.92	1.09	1.75	0.30	0.047	0.018
Diethyl ether	5.79	0.61	1.70	0.05	0.059	0.007
Dioxane	5.14	0.59	1.60	0.05	0.048	0.004
Acetone	6.36	0.45	2.05	0.20	0.061	0.006
Toluene	6.72	0.87	1.85	0.10	0.079	0.006
Benzene	6.45	0.99	1.85	0.10	0.072	0.012
Nitrobenzene	6.91	0.86	1.65	0.10	0.066	0.009
Carbon tetrachloride	7.57	1.00	1.90	0.10	0.091	0.023

Table IV. Cycling Tests on Wetted Paper

Liquid	1st Cycle: Load at 2% elongation, lb.	1st Cycle: Energy absorption, in.-lb.	2nd Cycle: Load at 2% elongation, lb.	2nd Cycle: Energy absorption, in.-lb.	3rd Cycle: Load at 2% elongation, lb.	3rd Cycle: Energy absorption, in.-lb.	Load at break, lb.	Break elongation at break, %	Energy absorption capacity, in.-lb.
				Machine Direction					
Air	6.98	0.0284	6.78	0.0114	6.69	0.0092	11.70	4.05	0.450
Water	1.45	0.0095	1.38	0.0040	1.36	0.0033	2.99	5.70	0.198
Ethyl alcohol	4.22	0.0300	3.94	0.0089	3.87	0.0071	6.38	4.02	0.271
Butyl alcohol	5.81	0.0322	5.02	0.0089	4.52	0.0064	8.70	3.88	0.292
Toluene	7.67	0.1029	6.89	0.0224	6.26	0.0167	8.70	3.62	0.299
				Cross Direction					
Air	3.08	0.0157	2.95	0.0057	2.92	0.0045	6.39	9.53	0.779
Water	0.47	0.0042	0.45	0.0021	0.44	0.0018	1.91	11.46	0.239
Ethyl alcohol	1.37	0.0128	1.26	0.0037	1.18	0.0025	3.63	11.54	0.507
Butyl alcohol	3.17	0.0295	2.80	0.0084	2.56	0.0058	4.68	8.86	0.556
Toluene	3.28	0.3400	2.80	0.0104	2.43	0.0074	5.08	9.64	0.621

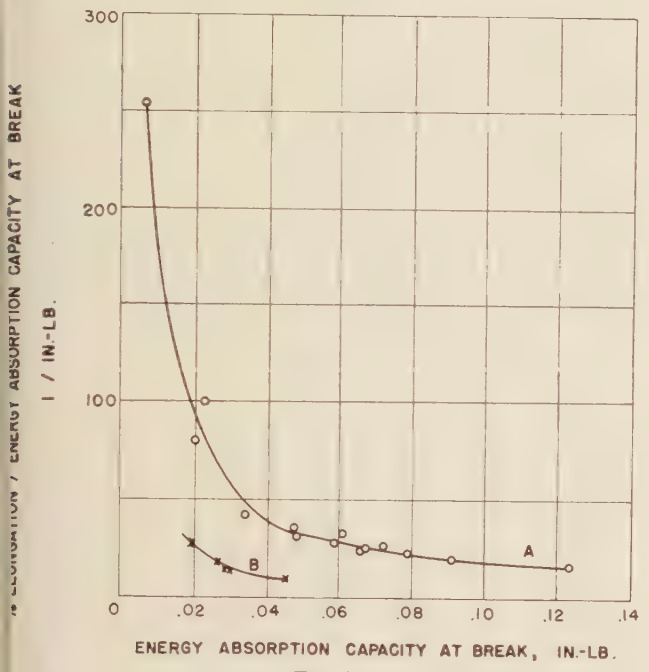

Fig. 2

n each of the three cycles was recorded, as were the reas of each hysteresis loop, corresponding to EF of ig. 1b. Finally the breaking strength in pounds, the longation, and energy absorption capacity to break in ie final cycle were recorded.

Table III shows the breaking strength, per cent elonation at break, and energy absorption capacity for a aterleaf paper (machine direction) when thoroughly et by water or by one of a number of organic liquids.

Table IV summarizes the stresses obtained on each of the 2% elongation cycles together with the areas of the hysteresis loops and the breaking strength, elongation and energy absorption capacity on the final elongation when a sulphite paper was wet with water, ethyl alcohol, butyl alcohol, or toluene. In order to check that no permanent changes were induced in the paper, some of the wetted sheets identical with those tested, were allowed to dry out from the liquid used, conditioned and broken in the same way as the other samples. Results are given in Table V.

When the papers of Part I were wet with water during determination of their stress-strain curves the results of Table VI were obtained. These data have been corrected as described in Part I so that cross comparisons with the values for the dry papers are possible. The assumption of constant strip density is probably unjustified but the high standard error of the results makes any further refinement unnecessary. For the same reason no recalculation of solid fraction correction was made when the paper was wetted with water. Furthermore, it seems reasonable to suppose that the solid fraction of a paper sheet should not change radically—i.e., in order of magnitude—with changing liquid and liquid content. Though wetting undoubtedly has some effect on relative distances from fiber to fiber, the swelling of the fibers themselves would appear to give the larger contribution to the expansion in sheet volume. Thus, the expansion in sheet volume may be considered as the sum of the individual fiber expansions plus the factor, probably small, caused by the increase, if any, of the distances between adjacent fibers through the sheet.

DISCUSSION

Owing to the difficulty of testing as many liquids as

able V. Comparison of Breaking Tests of Original Papers and Papers Wetted with Liquids and Allowed to Dry Before Testing

	Breaking load: Average, %	Breaking load: Standard deviation	Elongation at break: Average, %	Elongation at break: Standard deviation	Energy absorption capacity: Average, %	Energy absorption capacity: Standard deviation
			Machine Direction			
iginal paper	11.70	0.63	4.05	0.32	0.450	0.061
ater soaked and dried	10.63	0.62	5.10	0.02	0.503	0.047
hyl alcohol soaked and dried	11.37	0.46	4.36	0.53	0.482	0.079
tyl alcohol soaked and dried	12.07	0.26	4.65	0.93	0.545	0.147
			Cross Direction			
iginal paper	6.39	0.19	9.53	0.67	0.775	0.056
ater soaked and dried	6.44	0.14	10.61	0.88	0.840	0.078
hyl alcohol soaked and dried	6.49	0.28	9.30	0.40	0.756	0.058
tyl alcohol soaked and dried	7.13	0.24	9.65	0.57	0.900	0.083

Table VI. Values for Papers of Part I Measured Wet with Water

Paper	Wet: Corrected tensile strength, Average, lb./in.²/F_s	Wet: Corrected tensile strength, Standard deviation	Wet: Elongation, Average, %	Wet: Elongation, Standard deviation	Wet: Corrected energy absorption capacity, lb./in.²/F_s, Average, %	Wet: Corrected energy absorption capacity, lb./in.²/F_s, Standard deviation	Dry: Corrected tensile strength, Average, lb./in.²/F_s	Dry: Corrected tensile strength, Standard deviation	Dry: Elongation, Average, %	Dry: Elongation, Standard deviation	Dry: Corrected energy absorption capacity, lb./in.²/F_s, Average, %	Dry: Corrected energy absorption capacity, lb./in.²/F_s, Standard deviation
KAM	1380	70	3.20	0.05	32.7	1.9	14,800	1500	3.20	0.30	492	81
KAC	440	10	7.45	0.15	38.6	2.4	5,430	260	8.10	1.10	595	123
CAM	956	104	2.55	0.15	19.8	2.4	16,600	1100	3.50	0.20	500	78
CAC	490	13	5.20	0.20	29.6	2.1	7,180	490	4.35	0.55	409	86
R4A	250	14	6.95	0.50	22.8	2.6	6,730	780	3.45	0.75	276	82
R4B	242	16	3.55	0.30	9.69	1.7	8,220	930	4.15	0.75	428	12
K5B	325	11	2.95	0.10	9.62	0.84	18,200	700	5.10	0.35	1080	140

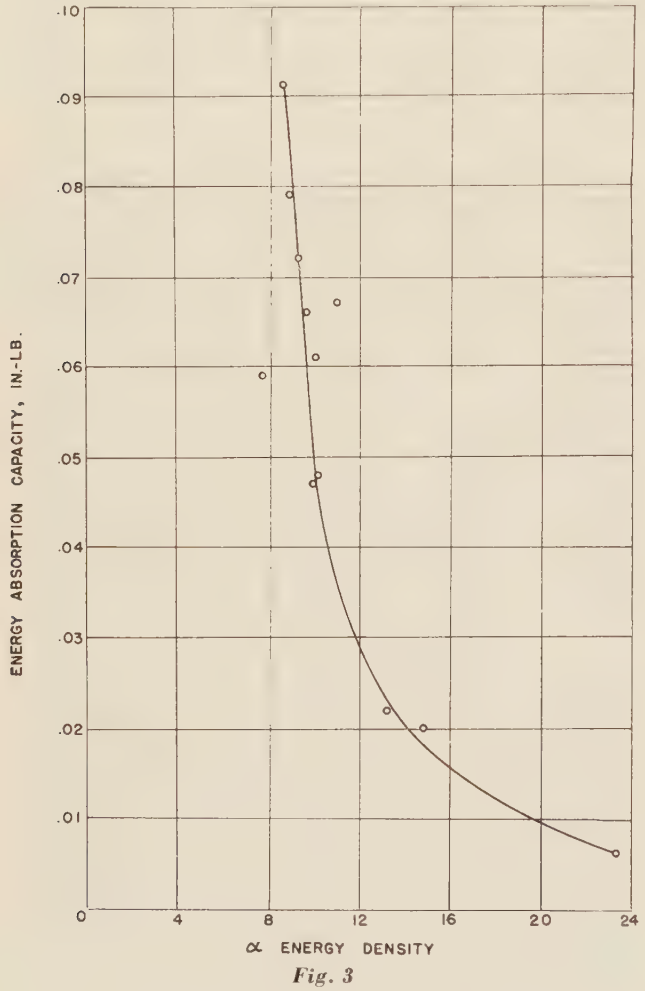

Fig. 3

would be desirable, it is only possible to draw certain broad conclusions from the first series of stress-strain diagrams run on the waterleaf sheet. If the fiber-to-fiber links are destroyed in any of the liquids used, it would be expected from our general knowledge of the stress-strain curves described earlier that elongation would increase as energy absorption at break decreased. While the figures of Table III do not indicate this too clearly because of the wide variation in strengths shown, it is perhaps helpful to reduce them to a more comparable basis by plotting the ratio of elongation at break to energy absorption to break versus absorption to break (Fig. 2). It is seen first, that a smooth curve is obtained, and second, that as the work to break increases, the elongation ratio drops very precipitately and then decreases almost linearly with energy absorption until the rupture point is reached (curve A). This is the behavior that might be expected if water destroys practically all the fiber-fiber bonds; restoration of only a small number would be sufficient to decrease markedly the elongation ratio which thereafter would change relatively little with decreasing number of interfiber links. If a paper with its fibers cross linked by primary valence bonds, unaffected by liquids (polar or nonpolar), were substituted for the waterleaf sheet of curve A, a curve

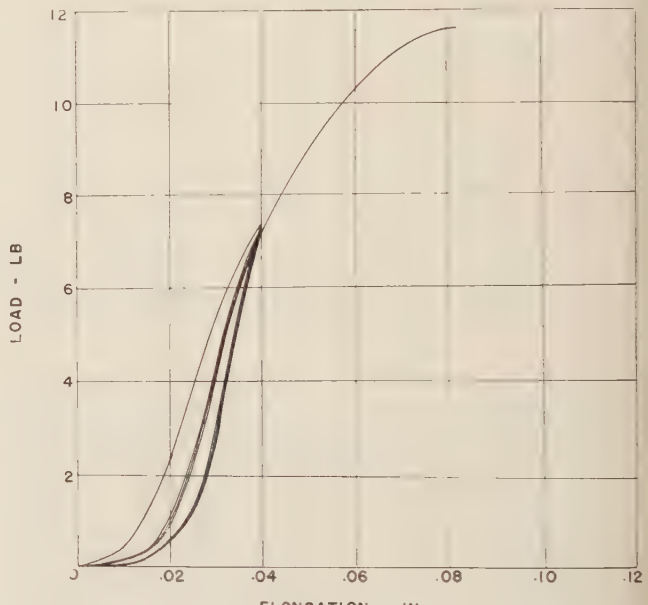

Fig. 4. Dry

Table VII. Breaking Strength and Energy Absorption Capacity Ratios

Liquid	$\frac{\text{C.D. breaking strength}}{\text{M.D. breaking strength}}$	$\frac{\text{C.D. energy absorption capacity}}{\text{M.D. energy absorption capacity}}$
Air	0.55	1.73
Water	0.64	1.20
Ethyl alcohol	0.57	1.86
Butyl alcohol	0.54	1.90
Toluene	0.58	2.08

Table VIII. Breaking Strength and Energy Absorption Capacity Ratios for Papers of Part I

	Breaking strength	Energy absorption capacity to break
$\frac{\text{KAC}}{\text{KAM}}$ (dry)	0.37	1.21
$\frac{\text{KAC}}{\text{KAM}}$ (wet)	0.32	1.18
$\frac{\text{CAC}}{\text{CAM}}$ (dry)	0.43	0.82
$\frac{\text{CAC}}{\text{CAM}}$ (wet)	0.51	1.49
$\frac{\text{R4A}}{\text{R4B}}$ (dry)	0.82	0.65
$\frac{\text{R4A}}{\text{R4B}}$ (wet)	1.03	2.35

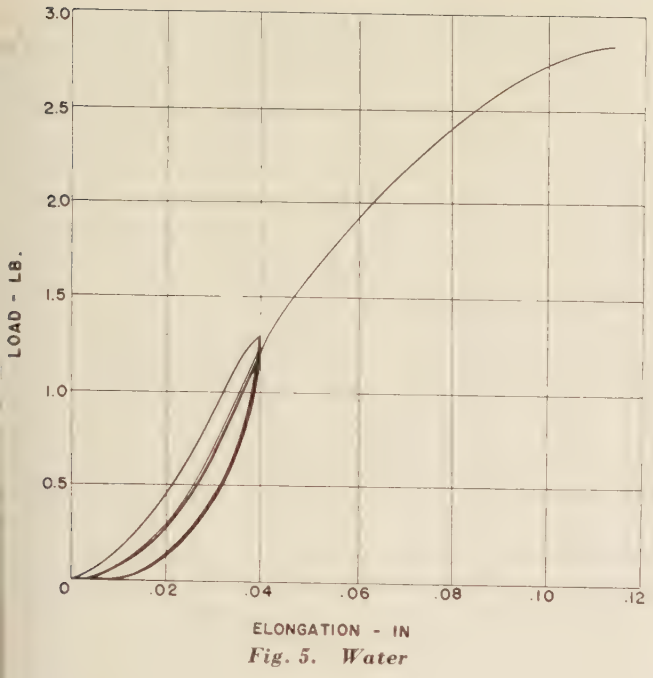

Fig. 5. Water

displaced below A might be expected. Some solvent susceptibility would remain, but the elongation ratio at any given work to break would always be lower. Curve B, representing the results of Table V for a sulphite sheet containing melamine-formaldehyde resin, falls qualitatively as might be expected from this picture.

A number of correlations with physical properties of the wetting liquids used were attempted. If sheet strength was due to mechanical friction between the intertangled fibers, liquid viscosity might be expected to be related to some of the curve characteristics. Actually it shows no correlation with any of the parameters investigated. Surface tension likewise showed no correlation. A plot of energy absorption capacity or breaking strength versus dielectric constant (E), showed some rough correspondence although the points were widely scattered. Better correlation, although still not good, was obtained when, following DeBruyne (*7*), energy absorption to rupture was plotted versus $(E-1)^{1/2}$. The method of correlation suggested by Ostwald (*21*) where rank is plotted on a chart of μ^2/E versus surface tension (σ), was also attempted with poor results. Values of the infrared hydroxyl-frequency displacement of CH_3OD dissolved in the liquid have been suggested by Gordy (*11, 12*) as an indication of hydrogen bonding power, but unfortunately are not available for most of the liquids used in the present work. For the data available there is a definite trend to lower energy absorption capacity at break as the bond-forming tendency of the liquid (evidenced by the increase in hydroxyl-frequency displacement) increases. Most satisfactory correlation was obtained with the energy density coefficient, α, defined by Magat (*18*) as:

$$\alpha = \sqrt{\frac{\lambda_0 - RT}{V}} \qquad (1)$$

where λ_0 is the heat of evaporation of the liquid at the absolute temperature T, R is the gas constant, and V its molar volume. Figure 2 shows the plot of energy density versus energy absorption capacity to break. Apart from the points for butyl alcohol and diethyl ether an excellent curve is obtained, indicating that liquids do influence the bonding between the paper sheets in the approximate order of their polarities, since energy density is closely related to polarity. It of course must not be forgotten that water was not entirely absent in any of the stress-strain experiments since the paper sheet was not specially dried before immersion in the liquid. This might account for the discrepancy shown by diethyl ether. In any event in view of the complex nature of intermolecular attractive forces, see, for example, Longuet-Higgins (*17*), and the more or less arbitrary choice of three quantities from the stress-strain curve, it seems unlikely that perfect correlation would be obtained, the best that can be hoped for is a broad relationship of the type of Fig. 2.

The preliminary survey indicates that the stress-strain characteristics are as might be expected if the fibers in the sheet are linked by secondary valence forces which can be broken by liquids capable of hydrogen bonding. As more of the fiber-to-fiber bonds are broken, with increase of the bond-forming tendency of the liquid, the elongation expressed in relation to the work to break increases at first slowly and then rapidly, simultaneously the work to break drops.

It was decided to investigate a few of the liquids used more thoroughly, cycling the paper to 2% elongation three times before finally increasing the elongation to the rupture point. Typical stress-strain curves for the dry paper and the same paper immersed in water, ethyl alcohol, butyl alcohol, and toluene are shown in Figs. 3 to 7 for the machine direction of the paper. Certain differences are at once apparent, apart from those already discussed in the breaking strength, elongation, and energy absorption capacity at break. In air and water, mechanical conditioning is almost complete after the first cycle, the stress required to produce 2% elongation being almost identical on the third cycle with that of the first. Toluene, in which we should expect no fiber-to-fiber links to be broken by action of

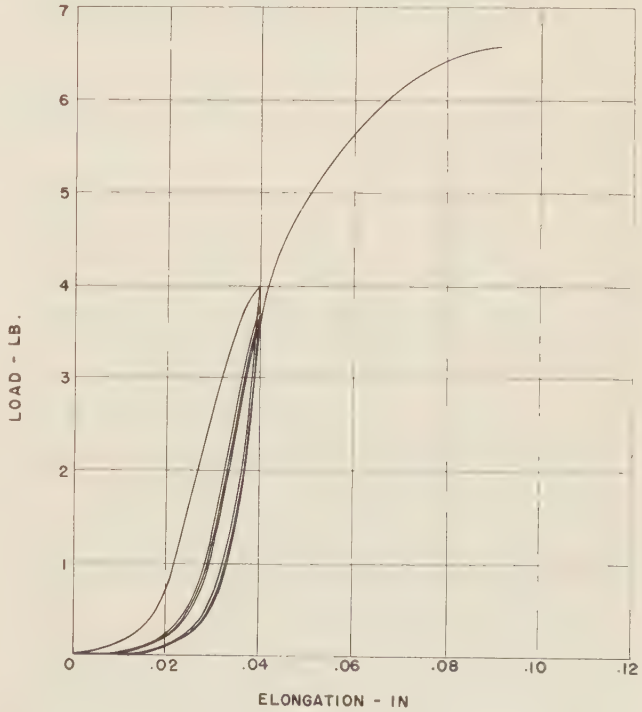

Fig. 6. Ethyl alcohol

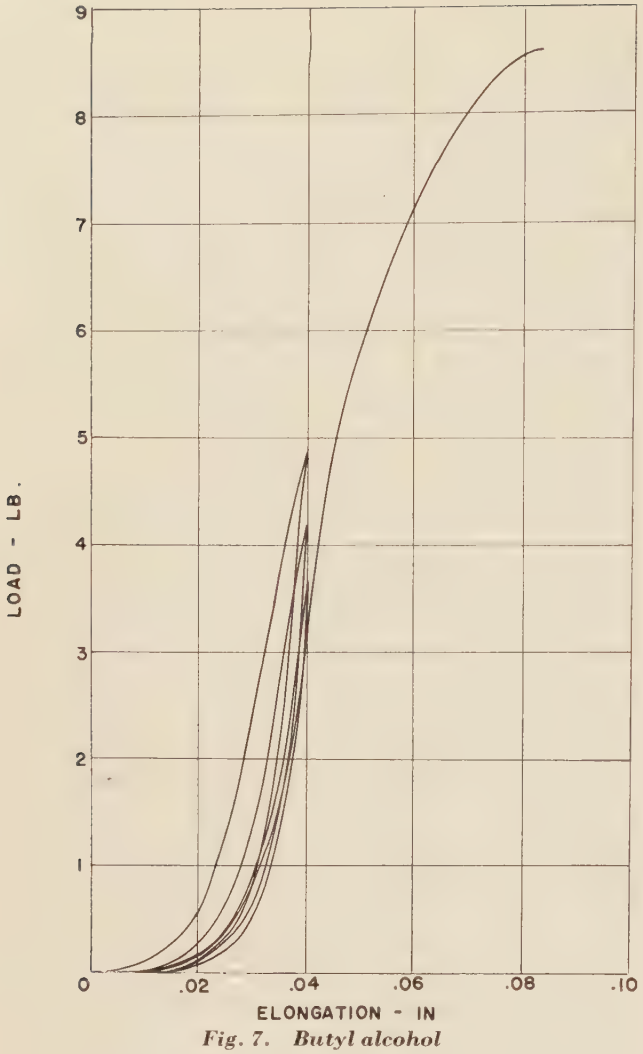

Fig. 7. Butyl alcohol

the liquid, behaves in a most interesting manner. The force required to reach the 2% elongation of the first cycle is high, 88% of the final breaking strength (machine direction) of the paper (Table IV). On the second cycle it decreases considerably and by the third cycle is only 72% of the final breaking load. In toluene there must be considerable flow or slippage of the fibers occurring upon successive applications of the strain, as well as breakage of the cross links between fibers. For water, the diagram is very different, corresponding to a structure with fewer cross links between fibers. While the force required to produce a given elongation is greatly reduced, the mechanical conditioning is essentially complete in one cycle, and thereafter the sheet is almost perfectly resilient. The force required for the third deflection is almost equal to that required for the first, in conformity with a major decrease in the number of cross links between fibers. The final slope of the curve (corresponding to E.F. of Fig. 1b) is also considerably less than that for toluene, corresponding to a greater ease of flow. Butyl alcohol and ethyl alcohol appear to fall in between water and toluene in their behavior, butyl alcohol showing the highest slope for the final portion of the curve.

Similar behavior is observed in the cross direction except that the load required to produce 2% elongation is a smaller percentage of the breaking load than in the machine direction. Thus, for water the figure 25% compared to 49%, for toluene 65% rather than 88. In this connection, it is interesting to look for effects which may be produced by strains sealed into the paper during making. Table VII shows the ratios of the cross direction and machine direction breaking strength and energy absorption capacities of the papers. Only water shows any sign of a closer approach to isotropic behavior, indicating a possibility of the release of frozen-in strains. The other liquids, in the case of energy absorption, move in the reverse direction.

Again the behavior of the wetted papers, as investigated in more detail, is consonant with the linking of the fibers by hydrogen bonds removed or broken in accordance with the polarity of the wetting fluid.

In the final series of experiments the papers of Part I were run, wet with only one liquid, water. All of the properties of the papers, with the partial exception of elongation, changed greatly. Inspection of Table VI, indicates that each paper exhibited a reduction of at least tenfold in breaking strength. The energy absorp-

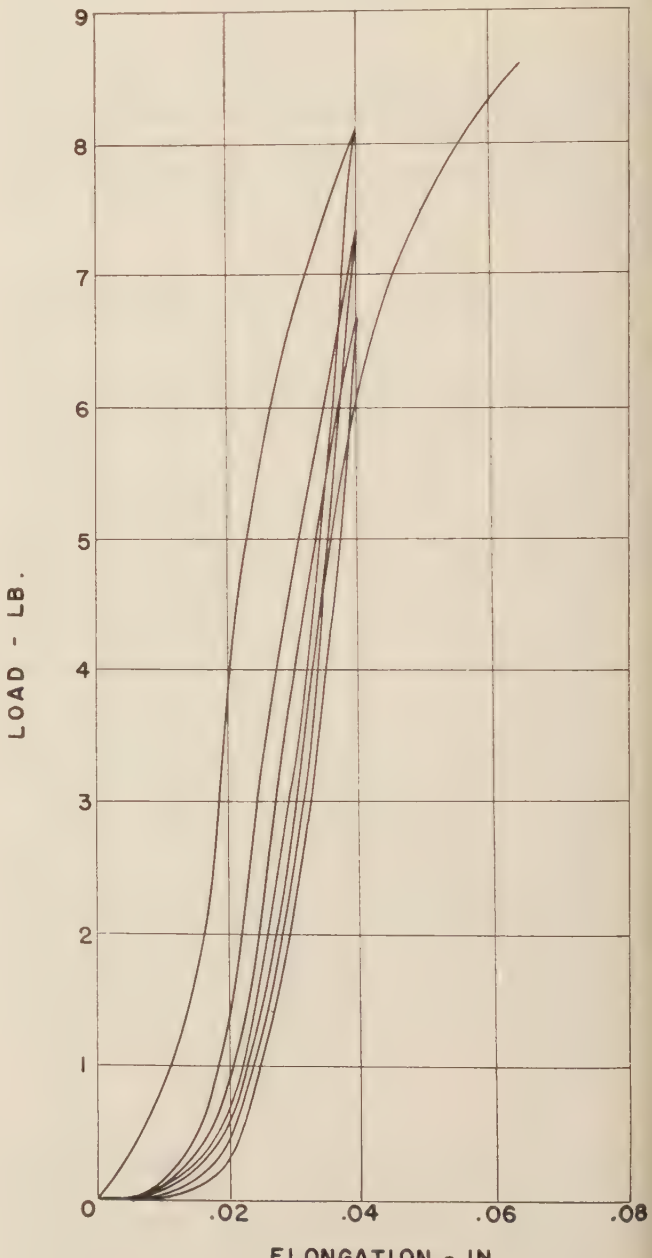

Fig. 8. Toluene

tion showed similar effects and, in the case of K5B, was reduced more than 100 times. Elongation was changed materially in only two cases; that of K5B was approximately halved, that of R4A about doubled. The latter case is of particular interest since it represents a long-fibered unbeaten pulp free from any kind of resins. Probably it possesses the smallest number of cross links or bonds in comparison to fiber length. When these are nullified by immersion in water, elongation actually increases from 3.45% for the dry paper to 6.95%. The beaten pulp, on the other hand, shows a decrease from 4.15 to 3.55, although the ratio of elongation to work to break still increases for R4B. This again seems to support the theory as to fiber-to-fiber bonding. Table VIII indicates that marked changes occurred in the breaking strength and energy absorption ratios due to machine direction and stock freeness, the latter particularly are of interest. In the dry state R4A has a lower strength and work to break than R4B, as to be anticipated from its unbeaten state. The fibrillae produced in R4B as a result of beating undoubtedly allow more links to be made between fibers with resultant higher energy absorption capacity and breaking strength. Because each sheet contains a large number of interfiber linkages, little difference in extensibility would be expected, although the elongation/work to break ratios are 0.0125 and 0.097 for R4A and R4B, respectively, which is in the direction to be anticipated. When wet with water, the secondary valence bonds are broken, and R4A requires more work for rupture as well as having the slightly higher breaking strength. This can be ascribed to its fibers, which unlike those of R4B are unshortened by beating. R4B now has the greater elongation/work to break ratio, 0.37, as compared with 0.30 for R4A.

While data of the type presented might be analyzed in terms of hypothetical models built up of elastic springs and viscous dashpots, as done by Steenberg and his coworkers (*1*), and such analysis is being currently carried out, it is hoped that presentation of these data, in terms of the simple concepts developed, may be helpful in the clearer understanding of the complicated nature of fiber bonding in the paper sheet.

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A Modified Cationic Urea Resin for Wet-Strength Papermaking

SVEN SÖNNERSKOG

Dicyandiamidine formate reacts with an acid solution of urea-formaldehyde (methylolurea) in water, giving a strongly hydrophilic resin where the polymer ion shows a cationic charge. At higher degrees of condensation the resin can be used for making wet-strength paper. Some data on its efficiency on bleached and unbleached pulps are given below.

Cationic urea resins seem partly to have replaced the older nonionic and anionic types to judge from recent reports (*1*). Their efficiency on various pulps is comparable to that of melamine under careful working conditions. The main difference appears to be a question of curing. Melamine resins are still to be considered as the class showing the more rapid rate of cure under comparable conditions (*2*). Furthermore, the durability of a melamine sizing on storage is definitively superior to that of urea resins, analogous to the stability of urea and melamine plastics on prolonged soaking in water.

Several possibilities stand open in selecting a modifying agent at the urea condensation in order to impart an ionic character to the finished resin. When a *cationic* charge on the polymer ion is wanted, the number of ways is considerably reduced and most of the suggestions mentioned in the patent literature are applicable only with little success. Strong organic bases such as guanidine have surely been used in industrial practice, but no statement confirming this, is made in the technical journals.

It is apparent that the modifying agent should fulfill

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Table I. Reaction Schedule at the Condensation of Dicyandiamidine Formate-Urea-Formaldehyde Solution

Time of reaction, hr.	*Temperature, °C.*	*pH*	*Notice*
0.00	15	7.1	Complete dissolution
1.00	63	7.2	Maximum temperature at the methylol reaction
1.30	58	7.2	Addition of formic acid
2.15	96	5.5	Condensation takes place
6.30	96	5.5	A sample precipitates in 80% methanol–20% water
12.30	96	5.5	A sample precipitates in 70% methanol–30% water
15.30	96	5.5	Precipitation is obtained on pouring 1 part of the resin into 5 parts ice-cold water. The precipitate dissolves on further dilution in water. Such a solution can be precipitated by an *anionic* polymer (e.g., sodium polyacrylic acid or sodium carboxymethyl cellulose)
15.40	96	7.0	Condensation stopped with 1 *N* sodium hydroxide solution
17.00	20	7.0	Analysis: dry content at 110°C.: 42%. Viscosity at 20°C.: 265 cp.

some general conditions to be suitable for taking part in the reaction. For instance:

1. It should be a most hydrophilic compound, preferably an electrolyte, showing a pH of about 7 in water.

2. The cation should be an organic base (an amino or amido compound), giving a methylene or methylene ether bridge on condensation with urea or methylolurea:

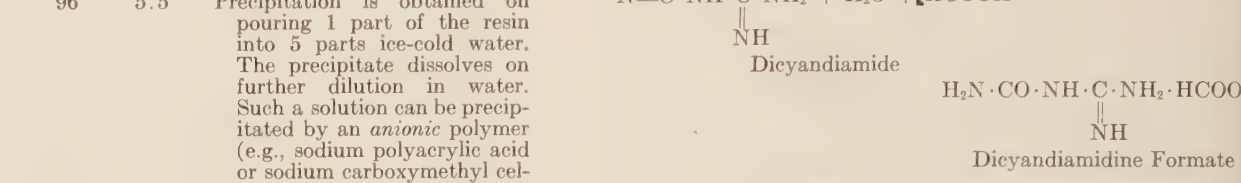
$$R\cdot NH_2 + HO\cdot CH_2\cdot NH\cdot CO\cdot NH_2 = R\cdot NH\cdot CH_2\cdot NH\cdot CO\cdot NH^2$$

3. The anion ought to be derived from the acid used for adjusting the acidity of the resin during the condensation step. This acid should further be a volatile one to avoid interference with the curing catalyst in the finished paper.

The considerations mentioned above have led us to choose dicyandiamidine formate as modifying agent. The preparation of this compound seems not to be reported in available literature, but it is easily obtained by hydration of dicyandiamide in diluted formic acid at the boiling point of the acid. A suitable composition of the reaction mixture is

1 part dicyandiamide
0.7 part formic acid, 85%, diluted with
0.6 part water

Dicyandiamide is added gradually to the refluxing acid during the course of 30 min. Boiling is continued for a further period of 30 min., when the hydration is considered as complete. The boiling point of the solution gradually arises to 112°C. The conversion is represented in the formula:



$$N\equiv C\cdot NH\cdot \underset{\underset{NH}{\|}}{C}\cdot NH_2 + H_2O + HCOOH = H_2N\cdot CO\cdot NH\cdot \underset{\underset{NH}{\|}}{C}\cdot NH_2\cdot HCOOH$$

Dicyandiamide — Dicyandiamidine Formate

The hot solution can be used immediately for cocondensation, but pure crystals of dicyandiamidine formate can easily be obtained in high yield if the solution is diluted with 0.4 part of water and slowly cooled to room temperature. In general 1.4 to 1.5 parts of dicyandiamidine formate separates on cooling to 15 to 20°C. The mother liquor may be used in a new synthesis of guanylurea, being only contaminated with minor amounts of by-products from side reactions (cyanuric acid, ammeline, and ammelide).

$$H_2N\cdot CO\cdot NH\cdot \underset{\underset{NH}{\|}}{C}\cdot NH_2\cdot HCOOH = C_3H_8O_3N_4$$

Analysis:

	% N (Kjeldahl)
Found	37.8
Calcd.	37.8

Condensation of dicyandiamidine formate-urea-formaldehyde is preferably carried out in a reaction flask equipped with a stirrer, reflux condenser, glass electrodes for use at elevated temperature, drop funnel for acid and base, and a feasible arrangement for taking samples every minute—if necessary.

Composition of a reaction mixture:

1 part dicyandiamidine formate
11 parts of urea
35 parts of formaldehyde, 37% solution in water

The adjustment of the pH during the methylol reaction is carried out by adding 1 *N* sodium hydroxide from a drop funnel. The acidity at the condensation step is regulated by 1 *N* formic acid, as shown in Table I.

Table II. Sizing of Paper with the Modified Urea Resin

Grades of pulp:
1. Bleached sulphite, 50°S.-R.
2. Unbleached sulphate, 52°S.-R.

Sizing in the defibrator:
1 part of the pulp (weight after drying at 110°C.)
5 parts of water
0.15 part of alum, dissolved in the water added

Urea resin:
1, 2, or 3%, calculated on the weight of the pulp

Curing (drying the finished paper sheet):
1. 30 min. at 70°C.
2. 30 min. at 120°C.

Table III. Effects of Cationic Urea Resin on Bleached Sulphite Pulp at Different Resin Contents of the Paper

Resin %	*Dry strength, lb./in.*	*Wet strength, lb./in.*	*Ratio, wet/dry, %*
1	23.6	5.5	24
2	22.8	9.3	44
3	22.9	9.3	44

Table IV. Effect of Cationic Urea Resin on Unbleached Kraft at Different Resin Contents of the Paper

Resin, %	*Dry strength, lb./in.*	*Wet strength, lb./in.*	*Ratio, wet/dry, %*
1	31.1	9.1	29
2	30.4	12.2	40
3	31.5	13.3	42

LITERATURE CITED

1. Fineman, M. N., and Gruntfest, I. J., *Tappi* 33: 357 (1950).
2. Gruntfest, I. J., and Young, E. M., Jr., paper presented before Technical Section, Canadian Pulp and Paper Association, January, 1950.

Received March 6, 1953.

ASSOCIATION NEWS AND EVENTS

TAPPI Coating Conference—1954

The TAPPI Coating Committee has announced that the Fifth Annual Coating Conference will be held May 24–26, 1954, at the Poland Spring House, Poland Spring, Me. This location was selected because of proximity to leading New England paper coating mills and the availability of adequate space for exhibitors.

Important features of the meeting will be a symposium on laboratory and pilot-plant development techniques for paper coaters, and mill visits to leading plants in the vicinity. An outstanding program of papers on coating technology has been arranged.

Officials of the S. D. Warren Co., Cumberland Mills, Me., the Oxford Paper Co., Rumford, Me., and the St. Regis Paper Co., Bucksport, Me., have invited TAPPI members to visit their coating mills during the conference. Guest speaker at the dinner to be held May 25 will be Rex W. Hovey, vice-president of the Oxford Paper Co.

An interesting exhibit of equipment and instruments pertaining to operation control, testing, and research in the paper coating field is being planned. Equipment manufacturers interested in participating are requested to get in touch with W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y.

Chairman of the sponsoring TAPPI Coating Committee is T. Trelfa, of the Watervliet Paper Co., Watervliet, Mich. Chairman of the Coating Conference Arrangements Committee is J. J. Thomas of the S. D. Warren Co. Assisting Mr. Thomas are J. T. Loomer of the Robert Gair Co., H. O. Ware of the Hercules Powder Co., G. S. McKnight, Jr., of the Oxford Paper Co., J. E. Wilber of the St. Regis Paper Co., R. C. Zettlemoyer of the National Printing Ink Research Institute, J. G. Bullard of the Corn Products Refining Co., H. N. Sprague of the St. Regis Paper Co., A. D. Bonanno of the Kelco Co., C. G. Landes of the American Cyanamid Co., and W. R. Willets of the Titanium Pigment Corp.

Local Section Meetings

Pacific: West Linn, Ore., March 19, 1954, Annual Shibley Award Competition; May 20–22, 1954, Gearhart Hotel, Gearhart, Ore.

Lake States: Wausau, Wis., March 9, 1954, Visit to Wausau Paper Mills, Brokaw, Wis. Symposium on "Test Methods," G. J. Brabender, Marathon Paper Mills, Rothschild, Wis., Moderator; Madison, Wis., April 13, 1954, Visit to Forest Products Laboratory.

Delaware Valley: Engineers Club, Philadelphia, Pa., March 25, 1954. Panel Discussion on "Odor and Food Packaging," April 27, 1954, Philadelphia, Pa. Discussion of Mill Instrumentation."

Kalamazoo Valley: Hotel Harris, Kalamazoo, Mich. Panel Discussion on "Graphic Arts," April 1, 1954, Engineering Program.

New England: Hotel Bond, Hartford, Conn., March 19, 1954; June 11–12, 1954, Annual Meeting.

Ohio: Hotel Manchester, Middletown, Ohio, March 9, 1954. Speaker—Sidney D. Kirkpatrick, Editorial Director, *Chemical Engineering:* April 11, 1954, Hartwell Country Club, Cincinnati, Ohio, Annual Meeting.

Empire State: Whiteface Inn, Lake Placid, N. Y., June 10–13, 1954, Annual Meeting.

Empire State (Metropolitan District): Fraunces Tavern, New York, N. Y., March 9, 1954, and April 13, 1954.

Empire State (Northern District): La Martinas Restaurant, Watertown, N. Y., April 8, 1954.

Empire State (Central District): University Club, Syracuse, N. Y., March 5, 1954. "Printing on Paper and Paperboard," by Frank B. Lincoln, Time-Life Laboratories, Springdale, Conn., May 7, 1954. New York State College of Forestry Night, Speaker—C. H. Kent, Hercules Powder Co., Holyoke, Mass.

Empire State (Eastern District): Glens Falls, N. Y., March 18, 1954. Discussion on "Centrifugal Cleaning Equipment"; April 15, 1954, Annual Junior Paper Presentation Competition.

Empire State (Western District): Queensbury Hotel, St. Catherines, Ont., March 9, 1954. Visit to Mill of Ontario Paper Co., Thorold, Ont. Joint Meeting with Niagara Branch, CPPA; April 14, 1954, Park Hotel, Lockport, N. Y., Annual Meeting. "Beauty by the Yard," by W. S. McClintock, Armstrong Cork Co., Lancaster, Ohio.

Maine-New Hampshire: Marshall House, York Harbor, Me., June 18–19, 1954.

Lake Erie: Hotel Carter, Cleveland, Ohio. Discussion on "Chemical Aids to the Paper Maker and Paper Converter"; April 16, 1954, Cleveland, Ohio, "Modern Woman Dictates Today's Product Development."

Southeastern: George Washington Hotel, Jacksonville, Fla., May 14–15, 1954, Hotel De Soto, Savannah, Ga.

CPPA Technical Section: Summer Meeting, Empress Hotel, Victoria, B. C., June 14–17, 1954.

APPM Superintendents Association: Annual Meeting, Sheraton-Mt. Royal Hotel, Montreal, P. Q., June 20–23, 1954.

Fundamentals of the Paper Machine

The Fundamental Research Committees of TAPPI and CPPA, Technical Section, are jointly sponsoring a four-day symposium centered about the fundamental processes occurring on a paper machine in the conversion of pulp slurries into paper. This symposium will be held at The Institute of Paper Chemistry, Appleton, Wis., Sept. 21–24, 1954. Speakers will concentrate on fundamental principles rather than upon engineering design or papermaking "art."

The program will cover the following general subjects:

1. Properties and Handling of Fiber Suspensions.
2. Mechanical Water Removal from Fiber Suspensions and Mats.
3. Cohesion, Adhesion, and Felting Properties of Fibers.
4. Mechanism of Heat Transfer and Water Removal and Effect on Sheet Properties.
5. Compression and Stressing of Fiber Mats.

Although the speakers cannot be listed at the present time, it is expected that experts in the various fields from Great Britain, Sweden, Finland, Norway, Germany, Canada, and the United States will appear as speakers and as members of discussional groups.

The following specific subjects will be included: Flow in Fiber Suspensions and the Effect of Turbulence; Specific Effect of Flocculation and of Air and Foam on Fiber Sus-

pensions; The Hydraulics of the Slice; Theory and Application of the Concept of Filtration; Water Removal by Table Rolls; Three-Dimensional Structure of Fiber Suspensions; Relation of Water Removal to Two-Sidedness; Water Removal by Means of a Dynamic Suction Box; Fiber Properties Involved in Adhesion, Cohesion, and Felting; Studies of the Wet Web Under High Rates of Elongation; The Effect of Water Removal on Sheet Properties; A New Method for Evaluating the Draw; The Fundamentals of Wet Pressing; Introduction of Strains Into the Sheet on Drying; Compression and Stressing in Calendering and Supercalendering.

The chairmen of the two cooperating committees are K. C. Logan of Northeastern Paper Products Ltd. for CPPA and Harry F. Lewis of The Institute of Paper Chemistry for the TAPPI committee.

Bark Studies

During the past year the Technical Association has been sponsoring a research project at the Forest Products Laboratory, Madison, Wis., on "The Anatomy of Common North American Pulpwood Barks."

The work has been carried on by Ying-Pe Chang in cooperation with the staff members of the Forest Products Laboratory and The Institute of Paper Chemistry. It was sponsored by the TAPPI Fundamental Research Committee.

Although the work will continue through the current year a monograph has been written to cover the work done to date. The contents of the monograph will cover the following chapters:

I. Introduction.
II. Material and methods.
III. The general structure of bark and its anatomical terms.
IV. Bark structure of common pulpwoods.
Although 20 species in 9 families of both softwoods and hardwoods are described, a total of 57 species of common timber trees were examined for the purpose of comparing the structure of closely related species. Details of the description for each species include the following items:
1. A brief introduction of that bark.
2. General features.
3. Anatomical structure.
(a) Young bark.
(b) Mature bark.
(1) Periderm or cork.
(2) Cortical region, if present.
(3) Secondary phloem.
(4) Transformation and rhytidome.
4. Characteristics and variations.
5. Comparison to related species.
V. Characteristics of bark structure of the species studied.
A. Significance of bark tissues.
1. Cell types.
2. Cell structure of important tissues—cell walls, shape, and size.
3. Cell contents.
4. Transformation of cell growth.
B. Relative volume of important tissues in bark—bark thickness and percentage of important tissues.
C. Diagnostic features.
1. Comparison of individual species and main groups.
2. Correlation with wood structure.
VI. Discussion—besides the above general results, other related problems will be discussed.
VII. Summary.
VIII. Literature cited.

New Corporate and Sustaining Members

The following companies have recently become corporate members of the Technical Association of the Pulp and Paper Industry:

Wartsila, Helsinki, Finland
Tielens Freres & Cia., Meerssen, Netherlands
Grycksbo Pappersbruk A/B, Grycksbo, Sweden
Celulosa de Chihuahua, Chihuahua, Mexico

The following companies have become sustaining members of the Association:

Keever Starch Co., Columbus, Ohio
Atlantic Refining Co., Philadelphia, Pa.
Crucible Steel Co., Pittsburgh, Pa.
Wisconsin Wire Works, Appleton, Wis.
Union Starch & Refining Co., Columbus, Ind.
Bowser, Inc., Fort Wayne, Ind.
Graver Tank & Mfg. Co., Taunton, Mass.
Dowell, Inc., Tulsa, Okla.
Fawick Airflex Div., Federal Fawick Corp., Cleveland, Ohio
H. Waterbury & Son, Oriskany, N. Y.
Seelye Stevenson Value & Knecht, New York, N. Y.
Edwin L. Wiegand, Pittsburgh, Pa.
Goulds Pumps, Seneca Falls, N. Y.

LETTERS TO THE EDITOR

Progress in Alkaline Pulping

To the Editor, *Tappi:*

I should like to draw your attention to a misstatement which appeared in the article "Progress in Alkaline Pulping—1952," by Stone and Wells, *Tappi* 36, No. 11: 38A (Nov., 1953).

The error occurs in the paragraph dedicated to agricultural residue pulping and refers to the mill at Radcliffe, England, as employing the Celdecor process (article reference 25). This is, however, not true and although this particular plant does operate some Celdecor equipment, centrifugal screens, and a wash filter, the system cannot be described as a Celdecor or Pomilio process. The plant, I believe, operates the soda process which is distinctly different from the soda/gas chlorine process.

G. W. Legg, *Chief Chemist*
Cellulose Development Corp., Ltd.
St. Paul's Cray, Kent, England

Nonaqueous Constituents in Pulp Mill Liquors

To the Editor, *Tappi:*

I would like to call your attention to an article which appeared in the November, 1953, issue of *Tappi* on page 504 by P. B. Borlew and S. Jerome Lancaster ("The Determination of Black Liquor Solids by Infrared Drying"). In particular, please note paragraph 4 in which the authors have misquoted information given in the article on a similar subject "Determination of Total Nonaqueous Constituents in Pulp Mill Liquors," by J. H. Phillips and M. M. Rubright which appeared in the September, 1953, issue of *Tappi*, page 392.

Borlew and Lancaster make the statement that Phillips and Rubright suggested the use of the Karl Fischer method for evaluating the total nonaqueous volatile constituents in pulp mill liquors by deducting the value as obtained for water through the Karl Fischer method from the value as found by oven drying.

"We can't praise our Conditioner too highly. We started up 15 months ago and we've never had to shut down to wash a felt and have never had any felt marks."

"With Vickery Conditioners we can keep our felts going at top speed right through the week and we estimate as much as ten extra tons per machine per day that used to be lost by slowing down for filled up felts."

USERS ARE DOING THE TALKING

"Up until the Conditioner was put in operation on one of our board machines average felt life was about six weeks. With the Conditioner the felt lasted three months. We are mighty well pleased and want more Conditioners for our other machines."

"What pleases us particularly is that we can now keep the weights on the presses during the entire run where formerly we had to take them off after three or four days. When the felts are finally cut off it's because they have lived a long and useful life, not because they fill up."

"Those Conditioners are saving us four to five wash-ups a week. The felts look so clean and fresh, visitors assume they're brand new."

"We've saved enough in felt life alone to more than pay for the Conditioners recently installed on our board machine. We no longer have any shutdowns during the week for felt wash-ups. I know it's hard to believe but the life of the felts has just about quadrupled."

VICKERY FELT CONDITIONERS

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This, of course, is not the intent since the modified Karl Fischer method proposed by Phillips and Rubright determines the moisture which when subtracted from the total sample weight determines the per cent total solids directly without reference to any values by oven drying or any other method of solids determination.

Further, Phillips and Rubright logically point out that, during oven drying, volatiles are driven off and organic decomposition occurs, thereby producing excessive values for moisture and correspondingly low values for solid content of the liquors.

In attempting to point out the above-mentioned error, Phillips and Rubright have made the statement in the second sentence of the Summary that a comparison of oven drying and titration results can be made and the difference is attributed to volatile constituents lost. However, there is certainly no intent to use this difference other than to establish that the oven drying procedures are in error.

I would also like to point out further than in the table on page 506 of the Borlew-Lancaster paper, a comparison of their data obtained by infrared with their data obtained by oven drying shows the infrared loss to be greater indicating carburization and decomposition of the liquor. It is desirable to eliminate this error as well as the error due to loss of volatile organic material.

We of the Babcock & Wilcox Co. consider that all combustible material including volatile organics and volatile inorganics as well as solids must be included in calculations for heat and material balances and the fact that the oven drying method does not include this volatile material results in an error in the above calculations. These errors have been eliminated in the Phillips-Rubright procedure and results from the use of that procedure provide more accurate data for engineering calculations of heat and material balances. While this error is not striking in kraft liquor, it becomes a major consideration in the sulphite-type liquors.

In the latter part of the above-mentioned paragraph on page 504 of the Borlew-Lancaster paper, these authors make a statement regarding proper equipment and the fact that preparation of reagents requires professional skill and attention. They also state that once the reagents are prepared, they must be isolated rigidly from atmospheric moisture.

The Phillips-Rubright paper definitely states that very little special equipment is required and nontechnical personnel have been used for the past two years in carrying out the Karl Fischer titration here. Further, it is also definitely stated that the particular reagents recommended by the Phillips-Rubright paper do not have to be protected from the atmosphere. These factors are very important inasmuch as they point out assets for the use of this method by operating personnel in pulp mills.

Since these misquotations and errors regarding the oven drying method may lead to misinterpretation of the benefits to be derived from other methods, I would like to ask your advice as to what steps should be taken to obtain a correction of the misquotation in the Borlew-Lancaster paper.

Chas. E. Rogers, *Research Engineer*
Babcock & Wilcox Co., Alliance, Ohio

To the Editor, *Tappi:*

This is in reply to a copy of a letter from Charles E. Rogers, The Babcock & Wilcox Co., dated Dec. 9, 1953, addressed to you.

Although Johansson developed fundamentally the application of the Karl Fischer method to water determinations in kraft black liquor, we felt that the literature quotation of Phillips and Rubright (*11*) was in order as an expression of courteous regard for the contributors to the novel idea of distinguishing between water content and volatilizable nonwater constituents of black liquors and the possibility of a quantitative determination by using a perfected technique for the former. We thought this to be clear in the light of our statement, page 506, Nov., 1953, *Tappi*, left column, last sentence of the third paragraph, suggesting the possible combination of the Karl Fischer and the infrared method.

Mr. Rogers is, of course, entitled to a justifiable criticism of our publication either by direct contact or publicly via a scientific-technical presentation and we are fully prepared to meet anybody on such grounds with due consideration. However, in view of certain inferences in his letter, we wish to go on record now as follows:

The easy operability of the Karl Fischer method is a matter of opinion and not a misstatement on our part.

We have no reason to consider lower solid content values obtained by infrared drying compared to those from oven drying as erroneous because resulting from a loss due to carburization or decomposition of the liquor. This point is borne out adequately by the satisfactory agreement between the xylene distillation and infrared values. Phillips and Rubright themselves present evidence that lower H_2O values from oven drying are attributable to retained moisture (page 397, left column, 4th paragraph).

In view of the statment of Mr. Rogers that the error of not including volatile organics and volatile inorganics in heat and material calculations of kraft liquor is not a striking one, we wonder in what respect our publication dealing with an improved and corrected way of determining the nonvolatilizable constituents of kraft liquor "may lead to misinterpretation of the benefits to be derived from other methods." On the contrary, as mentioned before, we were suggesting to explore the possibilities of a combination of Karl Fischer and infrared to further elucidate the composition of kraft black liquor. We feel that any technical or scientific method published stands on its merits to be evaluated in due course of time by all interested parties.

In order to avoid in the future any possible misinterpretation of the meaning of our statement with regard to literature reference (*11*) of our publication and if so desired by and satisfying to Messrs. Phillips and Rubright as the authors of the publication referred to, we are prepared to submit for an early issue of *Tappi* the request to substitute on page 504, Vol. 36, No. 11 (Nov., 1953), right column, line 18 from the bottom: "It was recently suggested (*11*) to use this method" by "This method, if performed as recently suggested (*11*) can be used."

Peter B. Borlew, *Technical Superintendent*
Container Corp. of America
Fernandina, Fla.

Speeds and Caliper in Folding Boxboard Manufacture

To the Editor, *Tappi:*

It has recently become of considerable interest to us at St. Anne's that we obtain some survey of the over-all picture in the States regarding the present production speeds of comparable types and calipers of folding boxboards to those which constitute our main product.

As you know we operate a rather wide range of calipers and substances, from 0.011/190-lb. (30 × 40–500) up to 0.045/644-lb. (30 × 40–500) with some 43% of our product over the 0.015/255-lb. (30 × 40–500) range. For the purposes of this query we would be particularly interested in the 0.015/255-lb. (30 × 40–500) range and upwards.

What we have in mind is for you to let us have possibly some knowledge of the maximum speeds at which these higher caliper types of board are being manufactured by the most up-to-date procedures at present operating in the United States. Any interesting details regarding types of machine and the operating widths and tonnages of individual machines would

WE DECIDED TO TAKE A FIRST STEP

We had long been fascinated by the idea of putting he amazing story of starches between the covers of single book. We realized that such a book would e a tremendous undertaking. The endless variety of arches, the ways they are produced, the creation of ew specialty starches, the miracle of 'man-made' arch derivatives, the handling of starches—even ese few subjects, covered in full, would make a rge volume.

A steady flow of requests for information about arches finally prompted us to take a first step with a page, semi-technical booklet. We have painted in broad strokes a panoramic picture of starches—their properties, production, application and handling.

We have included information of value to chemists and other technically trained people, in a way that will also be interesting to non-technical readers. Chemists, students, plant personnel, commercial management and all others who are interested in starches will find in this booklet something of value.

Copies of "The Story of Starches" may be obtained, without obligation, at National Starch's TAPPI Headquarters, Suite 1200, Hotel Commodore.

of course, be very helpful to us here, but we are particularly interested in what might be termed the over-all survey.

L. A. LAWRENCE, *Manager, Technical Dept.*
St. Anne's Board Mill Co. Ltd., Bristol, England

To the Editor, *Tappi:*

Replying to your letter of October 28 regarding folding boxboard machine speeds, the following may be of interest.

The optimum caliper for most machines in this country is about 0.024. On this thickness in a high-grade folding boxboard, speeds range from 300 to 350 f.p.m., to give a production of about 1.4 tons per in. of sheet width per 24 hr. Speeds on 0.015-caliper board run up to about 400 f.p.m., giving about 12 tons per in. of width. On calipers much above 0.024, the production per inch also drops off as the thickness increases and the speed decreases. About 125 f.p.m. is considered a good speed for 0.040-caliper boxboard.

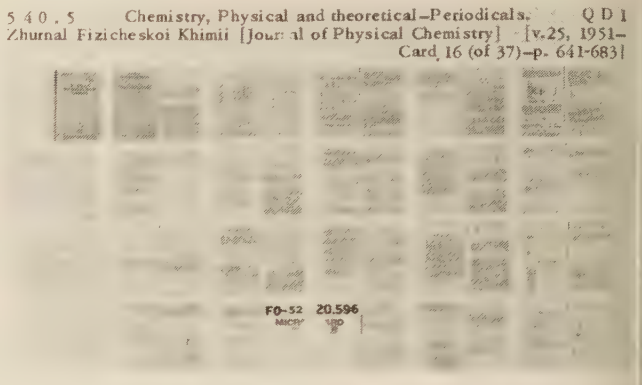
A. J. WINCHESTER
Technical Assoc. Pulp and Paper Industry
New York, N. Y.

Microcards

To the Editor, *Tappi:*

In studying the problem of building up industrial libraries in the paper industry, I have finally concluded, as have others before me, that costs of binding, cost of building space, unavailability of back issues, etc., necessitate adoption of improved techniques.

Although Microfilm is generally an improvement over the old style library in many respects, it has drawbacks. A further improvement has been made by the use of Microcards which are a $7^1/_2$ by $12^1/_2$-cm. standard library catalog card carrying a photographic reproduction of anywhere from 30 to 150 magazine pages made from a master negative. These cards are easily located as to paging, etc., and are read through a viewer. It has been said that when produced in reasonable quantity, a card costs about 10¢ so that a year's copy of a journal would be a very low priced item. It is understood, of course, that the Microcard copies would not be current with issues of the magazine so that the value of regular issues would be preserved.


5 4 0 . 5 Chemistry, Physical and theoretical–Periodicals. Q D 1
Zhurnal Fizicheskoi Khimii [Journal of Physical Chemistry] [v.25, 1951–
Card 16 (of 37)–p. 641-683]
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As our industry expands and technology finds even wider application the necessity for libraries will become even more apparent than at present. For that reason TAPPI could well take the lead for industry in this instance, as it has in so many others, to investigate the use of Microcards or other devices of this sort and to secure the cooperation of publishers of journals and sufficient orders from industry to insure production of sets of journals at the minimum cost.

If there is anyone in the paper industry who is interested in starting such a project, I will appreciate their comments.

T. T. COLLINS, JR.
P.O. Box 1620, Jacksonville, Fla.

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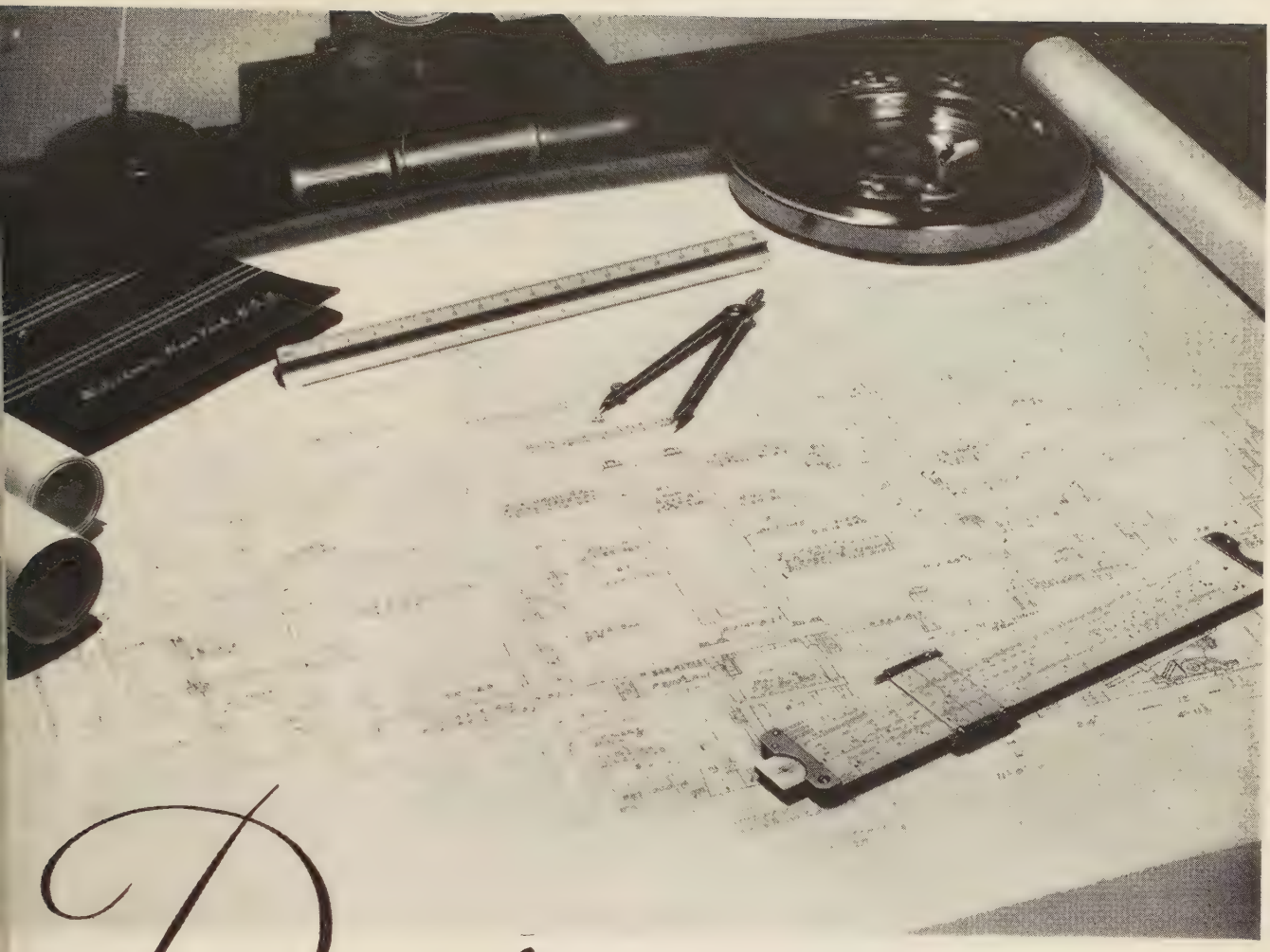

Design...

Designing the paper machine is important from every angle in that the economic life value of the mill is involved.

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Edward V. Ahara, Chief Engineer, Oxford Paper Co., Rumford, Me., a 1922 graduate of the University of Toronto.

Isao Awane, Acting Mill Manager and Chief Engineer, Kokura Mill, Jujo Paper Mfg. Co. Ltd., Tokyo, Japan, a 1923 graduate of Hiroshima Higher Technical College.

Pierre Bayle, Manager, Compagnie Marocaine des Cartons and Papiers, Port Lyautey, Morocco.

James C. Betty, Manager, Northwest Sales, E. I. du Pont de Nemours, Pigments Dept., Portland, Ore., a 1937 graduate of Georgia School of Technology.

Harold Bice, Senior Research Chemical Engineer, Burnside Laboratory, E. I. du Pont de Nemours & Co., Penns Grove, N. J., a 1941 graduate of the State University of Iowa.

J. Kenneth Boggs, Marketing Engineer, Esso Standard Oil Co., New York, N. Y., a 1932 graduate of Emory University.

Morris Breslouf, Chemist, Van Man, Inc., Brooklyn, N. Y., a 1947 graduate of Boston College.

Joseph A. Bryant, Jr., President, Bryant Chemical Corp., North Quincy, Mass.

John G. Callan, Assistant to President, Bird & Son, Inc., East Walpole, Mass., a 1934 graduate of the Massachusetts Institute of Technology.

Chia-Shin Chuang, Chief Technical Director, Hwa Ming Paper Manufactory, Taipei, Taiwan, China, a 1944 graduate of the National Central Polytechnic College.

Leslie Cleminson, Manager, New Developments, Abitibi Power & Paper Co. Ltd., Toronto, Ont., Canada, a 1925 graduate of Queens University.

Wm. John Crichton, Mill Superintendent, Alliance Paper Mills Ltd., Georgetown, Ont., Canada.

Earl C. Cunningham, Research Engineer, Pollock Paper Corp., Middletown, Ohio, a 1931 graduate of the University of Wisconsin.

Knut Dahl, President, Kamyr, Inc., Hudson Falls, N. Y., a 1947 graduate of Switzerland's Institute of Technology.

Henry S. Drinker, Jr., Manager, Pulp and Paper Div., The Foxboro Co., Foxboro, Mass., a 1937 graduate of Haverford College.

David G. Edwards, Group Leader, Fibreboard Products, Inc., Antioch, Calif., a 1939 graduate of Carnegie Institute of Technology, with a Ph.D. degree in Physical Chemistry.

Warren O. Erickson, Group Leader, Barrett Div., Allied Chemical & Dye Corp., Toledo, Ohio, a 1943 graduate of the University of Wisconsin.

Francis W. Flynn, Assistant Kraft Mill Superintendent, Crown Zellerbach Corp., Camas, Wash., a 1934 graduate of the University of Minnesota.

James M. Forrester, Project Engineer, Rust Engineering Co., Pittsburgh, Pa. Attended the University of Toronto.

Donald B. Foss, General Superintendent, Consolidated Paper Corp. Ltd., Laurentide Div., Grand'Mere, P. Q., Canada, a 1923 graduate of McGill University.

John D. Gaffney, Assistant Technical Director, Rhinelander Paper Co., Rhinelander, Wis., a 1936 graduate of Northeastern University.

John M. Gillespie, Chemist, Kelco Co., Chicago, Ill. Attended Western Michigan College.

Alex Glassman, Engineer, R. R. Donnelley & Sons Co., Chicago, Ill., a 1946 graduate of McGill University.

Samuel J. Hall, Jr., Chemist, Riegel Carolina Corp., Acme, N. C., a 1949 graduate of the University of Alabama.

Hiroshi Hasegawa, Managing Director, Shiraishi Kogyo Co. Ltd., Hyogoken, Japan, a 1934 graduate of Tokyo University.

Jack M. Hiltz, Assistant Technical Control Supervisor, St. Croix Paper Co., Woodland, Me., a 1949 graduate of the University of Maine.

Rufus E. Hollinger, Technical Representative, Pyroxylin Products, Inc., Chicago, Ill., a 1950 graduate of Franklin & Marshall College.

Yoshiichi Ishii, Manager, Sakamoto Mill, Jujo Paper Mfg. Co. Ltd., Tokyo, Japan, a 1926 graduate of Kumamoto High Technical College.

Gunji Ishikawa, Director, Fuji Library, Sano Tehkosho Co., Tokyo, Japan.

Gustave F. Jahnke, Jr., Quality Control Superintendent, Marathon Corp., Menasha, Wis., a 1949 graduate of Ferris Institute.

John E. Keleher, Vice-President, Douglas M. McBean, Inc., East Rochester, N. Y.

Sadao Kitaura, Professor, Institute of Science and Industry, Kyushu University, Hakozaki, Fukuoka, Japan, a 1934 graduate of Tohoku University.

Nils Klykken, Mechnical Engineer, Kamyr, Inc., Hudson Falls, N. Y., a 1933 graduate of Norway's Institute of Technology.

Syl R. Lipinski, Production Manager, F. J. Kress Box Co., Pittsburgh, Pa.

Paul Lippke, Instrument Manufacturer, Neuwied, Western Germany, a graduate of the Technical College, Hanover.

Junichi Matsuoka, Manager, Construction Engineering Dept., Honshu Paper Mfg. Co. Ltd., Tokyo, Japan, a 1928 graduate of Tokyo Imperial University.

Hilmar Mayer, Sales Agent for Paper Box Board and Converted Products, Chicago, Ill.

Donald G. McCrone, Mill Manager, Pulp Mills, The E. B. Eddy Co., Hull, P. Q., Canada, a 1927 graduate of the University of Toronto.

Toichiro Mori, Factory Manager, Naniwa Factory, Mitsubishi Paper Mill Co. Ltd., Osaka, Japan, a 1922 graduate of Tokyo Technical College.

Fumio Muramatso, Manager, Fushiki Mill, Jujo Paper Mfg. Co. Ltd., Tokyo, Japan, a 1926 graduate of Waseda University.

Percy L. Nelson, Power Plant Engineer, Chas. T. Main, Inc., Boston, Mass., a 1943 graduate of Williams College, and a 1947 graduate of Massachusetts Institute of Technology.

Clyde M. Norcross, Chief Chemist, Champion Paper & Fibre Co., Hamilton, Ohio, a 1928 graduate of Ohio State University.

D. George O'Dell, Research Supervisor, Textile Fibers Dept., E. I. du Pont de Nemours & Co., Inc., Waynesboro, Va., a 1950 graduate of Purdue University with a Ph.D. degree.

Malcolm J. Odell, Technical Director, Angier Corp., Framingham, Mass., a 1935 graduate of the U. S. Naval Academy.

Toshio Okita, Assistant Manager, Kyokuto Boeki Kaisha Ltd., Tokyo, Japan, a 1939 graduate of Hokkaido University.

Walter F. Otto, Chemist, St. Regis Paper Co., Central Technical Dept., Deferiet, N. Y., a 1947 graduate of Illinois Institute of Technology.

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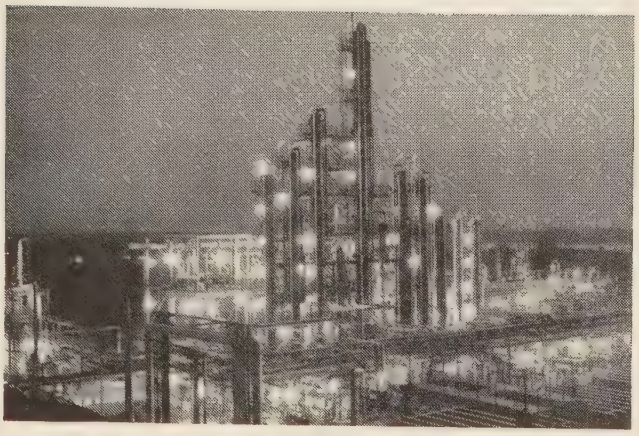

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T-2

Theodore R. Rastall, Sales Engineer, General Electric Co., New York, N. Y., a 1937 graduate of Rutgers University.

Norman R. Reamer, Coordinator, Graphic Arts Information Service, Rochester Institute of Technology, Rochester, N. Y., a 1932 graduate of the University of Michigan.

Wayne E. Robinson, Technical Supervisor, Pulp Bleaching, Champion Paper & Fibre Co., Pasadena, Tex., a 1933 graduate of the Georgia School of Technology.

Rafael Rojas, Director General, Laboratories Nacionales de Fomento Industrial, Mexico, D. F., Mexico, a 1940 graduate of Escuela Nacional de Ciencias Quimicas.

Robert A. Roof, Supervisor, Quality Control, Continental Can Co., Inc., Shellmar-Betner Div., South Gate, Calif., a 1949 graduate of Whittier College.

Kazuo Sano, President, Sano Iron Works Co. Ltd., Tokyo, Japan, a 1928 graduate of Nippon University.

Tsuneji Shiraishi, President, Shiraishi Kogyo Co. Ltd., Tokyo, Japan, a 1910 graduate of Kogakuin College.

Herman Skolnik, Manager, Hercules Powder Co., Experiment Station, Wilmington, Del., a 1943 graduate of the University of Pennsylvania.

Roger A. Somsen, Student, Institute of Paper Chemistry, Appleton, Wis., a 1953 graduate of the University of Wisconsin.

Evans C. Spiceland, Chemist, Hollingsworth & Whitney Paper Co., Mobile, Ala., a 1939 graduate of Mississippi State College.

Norman J. Stein, Sales Agent, Kraft and Sulphite Papers, Holyoke, Mass.

Benjamin R. Strong, Research Chemist. Rhinelander Paper Co., Rhinelander, Wis., a 1949 graduate of the University of Wisconsin.

Koiti Takamatsu, Chief Engineer, Hokuestu Paper Making Co. Ltd., Niigata City, Japan, a 1937 graduate of Tokyo Technical College.

Takeo Takayanagi, Executive Director and Manager, Jujo Mill and Laboratory, Tokyo, Japan, a 1922 graduate of Tokyo University.

Kozumasa Tanaka, Director, Kyokuto Boeki Kaisha Ltd., Osaka, Japan, a graduate of Tokyo University.

Robert M. Thibadeau, Assistant Sales Manager, Burgess Pigment Co., Paterson, N. J., a 1947 graduate of Georgia Institute of Technology.

Ernest Travnik, Director, Forest Products Research Institute, Bratislava, Czechoslovakia, a 1936 graduate of the Forestry College.

Rudolph L. Tressner, General Superintendent, the Ottawa River Paper Co., Toledo, Ohio. Attended St. Louis University.

TAPPI Notes

Richard S. Buckley, formerly of Potlatch Forests, Inc., is now a Field Service Engineer for the Lockport Felt Co., Newfane, N. Y.

Frank Z. Calkier, formerly with the Oronite Chemical Co., is now a Sales Representative for the Tennessee Corp., Atlanta, Ga.

Harry B. Conner is now Assistant General Superintendent of the Oxford Paper Co., Rumford, Me.

George B. Creamer is now Manager of Technical Service for Rayonier, Inc., New York, N. Y.

Robert R. Davis is now Assistant Manager of the Processing Material Div. of Sinclair Refining Co., New York, N. Y.

Paul Easton, formerly of Sveen-Pederesen Sales Corp., is now the Southern Sales Representative of the Lockport Felt Co. and will soon be located at Starkville, Miss.

H. O. Ehrisman is now Assistant General Sales Manager of the Foxboro Co., Foxboro, Mass.

R. K. Erhardt, formerly of the Wilson Paper Box Co., is now Production Manager of the National Paper Co., Atlanta, Ga.

Jakob Falkenberg, formerly with Mathieson-Eidswald Vaerk, is now Managing Director of A/S Tofte Cellulosefabrik, Oslo, Norway.

Eugene D. Frost, formerly of the Gaylord Container Corp., is now Chemical Engineer with Development Laboratory, Control Research Dept., Crown Zellerbach Corp., Camas, Wash.

Paul L. Gilmont is now Head of the Pulp and Paper Section, Research Div., the Crossett Co., Crossett, Ark.

Paul A. Goodlae is now Assistant Director of Research and Development of the Brown Co., Berlin, N. H.

Charles G. Griffin, Jr., has been transferred from Kimberly, Wis., to Memphis, Tenn., as a Chemical Engineer for the Kimberly-Clark Corp.

John C. Harper is now Chief Engineer for the Downingtown Mfg. Co., Downingtown, Pa.

John H. Heuer is now Technical Director of the Research and Control Dept., Great Northern Paper Co., Millinocket, Me.

Robert E. Ingeson, formerly of the Harvard Paper Mills, is now in the Research Dept. of the Oxford Paper Co., Rumford, Me.

Theodor Kleinert, formerly of Zellwolle Lenzing A/G, is now a research associate for the Pulp and Paper Research Institute of Canada, Montreal, P. Q.

Ralph Lampo, formerly of the Arvey Corp., is now a Chemical Engineer for the Adhesive Products, Inc., Albany, Calif.

John G. Langley is now Mill Engineer for the Donnacona Paper Co., Donnacona, P. Q.

Elisha B. Lewis, formerly of the University of Chattanooga, is now a Research Chemist for Behr-Manning Corp., Troy, N. Y.

Jack Mazer is now President of the Hudson Pulp & Paper Co., New York, N. Y.

Robert L. McCray, formerly Engineer of the Crossett Lumber Co., is now with the Valentine Pulp & Paper Co., Thibodaux, La.

C. J. McDowell is now Sales Manager of the Chemical Div. of Corn Products Refining Co., New York, N. Y.

Jack McKela, formerly of the Dilts Machine Co., is now Mill Manager of the Atlas Paper Board Co., Long Island City, N. Y.

Wm. R. McKelvy is now Assistant to the Chairman of the Board of Fulton Bag & Cotton Mills, Atlanta, Ga.

Jaime Ortiz Mena, formerly with National Financiers, S. A., is now Coordinator for Celulosa de Chihuahua, Chihuahua, Mexico.

Harry C. Merritt is now Executive Vice-President of the Downingtown Mfg. Co., Downingtown, Pa.

William H. Palm is now President and General Manager of Hinde & Dauch Co. of Canada Ltd., Toronto, Ont.

Leslie P. Peck, formerly of the National Folding Box Co., Inc., is now Assistant Superintendent of the Mac Sim Bar Paper Co., Otsego, Mich.

David F. Pollard is now Assistant Technical Director of the Great Northern Paper Co., Millinocket, Me.

James W. Purdey has been transferred from the Thunder Bay Div. to the Fort William Div. of the Abitibi Power & Paper Co., Fort William, Ont.

Edward M. Pyatt, Jr., formerly of Ball Bros. Co., is now Chemical Engineer for the Inland Container Corp., Indianapolis, Ind.

Robert Rosenbaum, formerly of the Pollock Paper Corp., is now Research Chemist in the End-Use Laboratory of Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp., Tonawanda, N. Y.

William H. Schlafge is now Production Manager of the Paper Div., Minnesota Container Paper Co., International Falls, Minn.

George H. Sheets has been transferred from Chillicothe, Ohio to Kingsport, Tenn., as Assistant to the Division Manager

How controls pitch trouble... at lowest cost

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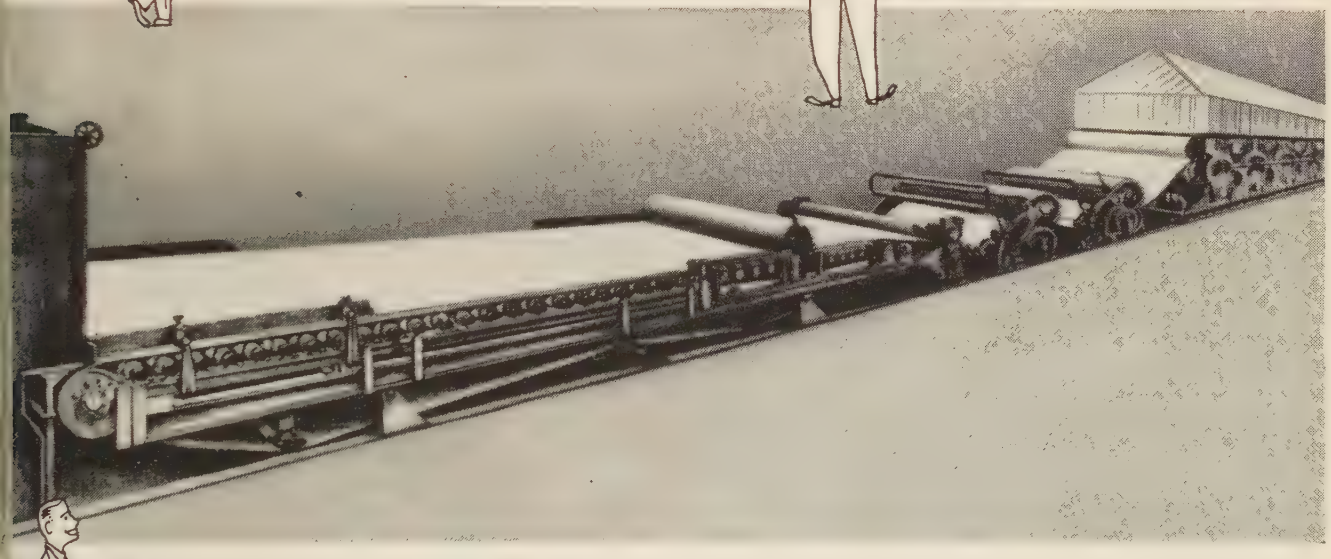
pitch particles
destroys stickiness

keeps

machines cleaner
longer



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William S. Spiller, formerly of the Marinette Paper Co., is now Paper Mill Shift Supervisor for the Scott Paper Co., Everett, Wash.

Norbert F. Toussaint, formerly of Ditto, Inc., is now a Manufacturers' Representative in Skokie, Ill.

Leroy C. Watson is now Vice-President in Charge of Production of the Hubinger Co., Keokuk, Iowa.

Chris C. Wright, formerly of Case Bros., Inc., is now Superintendent of the Wallomsac Div., Columbia Box Board Mills, Inc., Wallomsac, N. Y.

William R. Zwecker is now a Consulting Engineer, located at 707 W. 5th St. (Room 605), Los Angeles, Calif.

* * *

R. A. Premo, Assistant Production Manager, has succeeded *John S. Brush* as the official corporate representative of the Gould Paper Co., Lyons Falls, N. Y., in the Technical Association.

William Conner has succeeded *Henry H. Ogden*, Executive Vice-President, as the official corporate representative of the Atlanta Paper Co., Atlanta, Ga., in the Technical Association.

John Stevens, Jr., President, has succeeded *D. C. Everest* as the official corporate representative of the Marathon Corp., Rothschild, Wis., in the Technical Association.

R. J. Suess, President, has succeeded *D. H. Greene* as the official corporate representative of the Otsego Falls Paper Mills, Otsego, Mich., in the Technical Association.

* * *

The firm of Myers & Addington, consulting engineers in New York City, has been dissolved. Two of the partners, David Moffit Myers and Michael Pope, have joined the firm of Seelye Stevenson Value & Knecht, consulting engineers, in New York City, a TAPPI sustaining member which is now represented by Michael Pope.

William W. Alderman has succeeded *Samuel J. Hefti* as the official representative of Hart & Harrington, Inc., Chicago, Ill., in TAPPI.

Howard J. Soriano, Vice-President and Secretary, has succeeded *Harry B. Van Antwerp* as the official representative of Sinclair & Valentine Co., New York, N. Y., in the Technical Association.

Charles J. Weidmann, Technical Director, has succeeded *J. P. Bauer* as the official representative of Ciba Co., Inc., New York, N. Y., in the Technical Association.

Percy H. Tomlinson, Manager of Rolls Sales, has succeeded *Albert C. Seaton* (retired) as the official representative of Farrel-Birmingham Co. in the Technical Association.

Industry Notes

Production

In October the paper industry continued its record-breaking performance by producing an estimated 2,435,000 tons, exceeding the previous high of May, 1951, by about 30,000 tons. The large quantity produced in October was in a sense, to be expected because industry output normally reaches its annual peak during that month. Nevertheless, its achievement at a time when there existed several indications that industrial activity in general was receding from its previously high level may be considered to be indicative of the relative strength of the paper industry at this time.

Although the large production of October was accompanied by a volume of new orders which, at 2.3 million tons, was equal to that of the preceding month, large shipments and a decrease in the volume of new orders received by paperboard mills caused the total backlog of mill orders to decrease.

The production of printing and similar papers continued to set the pace for the paper branch of the industry by turning out 324,000 tons, raising the output for the year to date to slightly more than 3 million tons. At the close of the month the backlog of unshipped orders for these papers was slightly less than at the end of September as new orders of 314,000 tons failed to equal shipments.

Fine paper mills, in terms of production, enjoyed their best month since March, 1951, as their output mounted to 119,000 tons. Although the backlog of orders held by these mills continued the decline which set in following their July peak, it was at a level comparable with that maintained during the first half of the year. Stocks on hand rose slightly from their Summer volume to approximate that which existed in the early part of the year.

The production of coarse papers rose to 303,000 tons in October, to achieve their greatest output since March, 1951. Although the backlog of orders for these mills dipped slightly, it continued at a high level as new orders of 301,000 tons were only slightly below shipments.

Newsprint production showed greater strength in October than at any other time this year, rising to 97,000 tons, the largest volume produced monthly in the past 18 months. Contrary to most of the industry, production was slightly in excess of shipments, causing stocks on hand to rise.

The paperboard branch of the industry producing an all-time high of 1,163,000 tons, played a major part in the establishment of the record output of the month. Simultaneously, however, orders received during the month were 60,000 tons less than in September, and unfilled orders decreased by 97,000 to 530,000 tons. Since that time, the decrease has continued and by the middle of November unfilled orders had been further reduced to approximately 480,000 tons, the lowest level since February and almost 25% less than the high point reached at the close of September.

Wood Pulp

Wood pulp production for 1953 through September amounted to 13,092,000 tons, an increase of 833,000 tons over the comparative period last year. Consumption of wood pulp continued high, in line with the record paper and paperboard production building up for this year. By the end of September 13, 956,000 tons of wood pulp had been consumed, an increase of 1,133,000 tons over the January–September period last year. Exports of wood pulp for 1953 through September were 99,000 tons, 79,000 tons less than for the same period last year. Imports of wood pulp continued high and by the end of September were 1,621,290 tons, an increase of 274,720 tons over last year for the same period. The principal increase was from Europe, 241,491 tons, the remainder of the increase occurring in imports from Canada. Inventories declined moderately during September and at the end of the month totaled 665,000 tons, a decline of 18,000 tons from the level of the previous month, but 15,000 tons more than inventories at the end of September, 1952. Pulp mill inventories were 147,000 tons and paper and board mill inventories were 518,000 tons.

Total wood pulp imports, based on data received from the Bureau of the Census, for the first ten months of 1953, in comparison with the first ten months of 1952 are as follows:

	1953[a]	*1952*[a]	*Per cent change*
Canada	1,345,853	1,297,974	+4
Sweden	280,931	115,591	+143
Finland	134,945	88,554	+52
Norway	32,893	14,099	+133
Germany	588	169	+248
France	211	119	+77
Austria	9,783	400	...
Total Europe	459,351	218,936[b]	+110
Total World	1,805,204	1,516,910	+19

[a] Short tons.
[b] Includes 4 tons from Australia.

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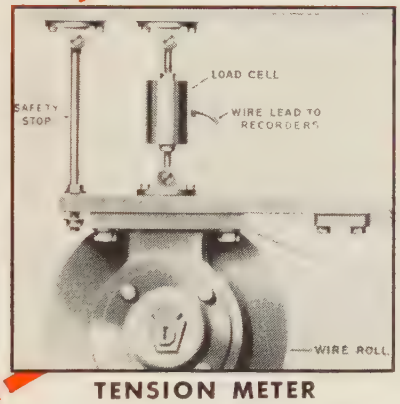
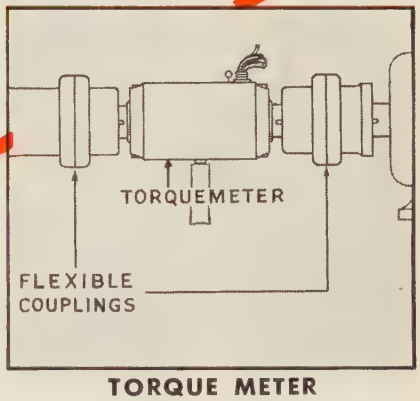
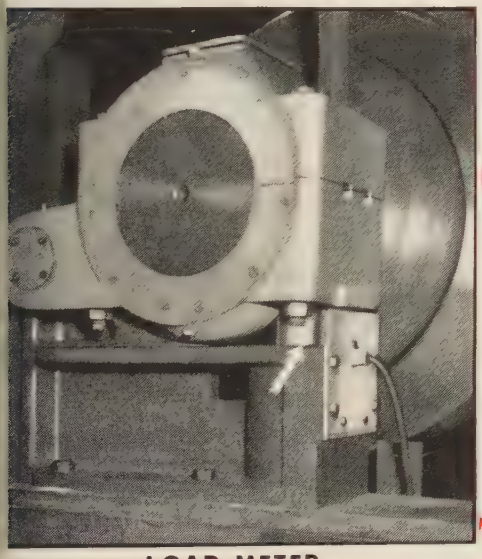


TENSION METER
Installed on a wire roll of a Fourdrinier Machine.



TORQUE METER
Installed between a drive unit and any driven roll.



LOAD METER
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Pulpwood

Total receipts of pulpwood for the January–September period this year amounted to 20,724,000 cords, approximately the same as for the comparable period in 1952. Domestic receipts increased 770,000 cords, while imports declined 730,000 cords. Regionally, declines were reported in the Northeast and Lake states of 38,000 cords and 445,000 cords, respectively, while increases in the other three regions ranged from 132,000 cords in the Pacific Northwest to 1,188,000 cords in the South.

Pulpwood consumption for 1953 through September totaled 21,019,000 cords, an increase of 1,289,000 cords over the same period last year. The Northeast region showed a decline of 166,000 cords while in the other four regions increases ranged from 101,000 cords in the Appalachian to 1,091,000 cords in the South.

Inventories of pulpwood at the end of September were 5,628,000 cords, 378,000 cords less than at the end of September, 1952. Decreases were reported in the Northeast, Appalachian, and Lake states regions ranging from 12,000 cords in the Appalachian to 322,000 cords in the Northeast. In the South and Pacific Northwest increases of 188,000 cords and 60,000 cords, respectively, were reported.

Newsprint

Production in Canada (including Newfoundland) during November, 1953, amounted to 473,176 tons and shipments to 491,450 tons. Output in the United States was 92,385 tons and shipments were 90,847 tons, making a total North American production of 565,561 tons and shipments of 582,297 tons compared with continental production of 553,277 tons and shipments of 589,416 tons in November, 1952.

The Canadian mills produced 24,297 tons more in the first 11 months of 1953 than in the corresponding period of 1952, which was an increase of 0.5%. The output in the United States was 65,879 tons or 6.2% below that in the first 11 months of last year, thus the net continental decrease under production in the comparable period of 1952 amounted to 41,582 tons or 0.7%.

Stocks of newsprint paper at the end of November were 126,490 tons at Canadian mills, and 8610 tons at United States mills, making a combined total of 135,100 tons compared with 151,836 tons on October 31, 1953, and 130,273 tons at the end of November, 1952.

Wastepaper

During the last part of 1953 Eastern mills purchased and consumed a weekly average tonnage of wastepaper higher than any time during the last 5 years, since the first half of 1951, which topped all years to date in wastepaper purchases and consumption. The average weekly purchases and consumption of wastepaper since last July 1 is running about 15% below that of the first half of 1951.

In both receipts and consumption, the cumulative total in 1953 topped that of the entire year 1950. On October 24 more wastepaper had been received and consumed than during the entire year 1949, and on November 2, more had been purchased and consumed than during all of 1952. On November 21, more had been bought and used by the Eastern mills than during the entire year 1946.

As far as can be ascertained at this time, no shortage of the news grades of wastepaper resulted from the strike which prevented the publication of New York City's newspapers. The strike which began on November 28 terminated on December 8, its eleventh day.

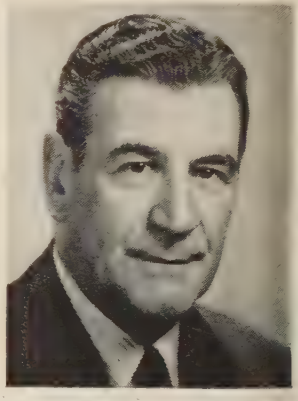
Publication of newspapers of enormous size since the end of the strike has made possible record-breaking collections throughout the metropolitan area. The Sunday newspapers, especially those of December 13 and 20, required many thousands of tons of newsprint over the normal requirements, while the daily papers up to the present time have been of abnormal size, made necessary by hundreds of pages of holiday advertising.

Circulation of the New York Sunday papers aggregates between 8 and 9 million copies per issue. A wastepaper dealer who purchased one of each of the five Sunday papers on December 13 said their combined weight was over 16 lb. The *New York Times* on December 13 published a 436-page newspaper, which weighed 5 lb.. printing 1,300,000 copies. This edition, according to the *Times*, required 3297 tons of newsprint. For this Sunday edition alone, consisting of 4500 long rolls of paper, 110 railroad cars were required to transport the paper from the mill to New York, and 264 heavy trucks were used to haul it to the *Times* presses.

The *Sunday News*, a tabloid, with a circulation of more than 4 million; the *Journal-American*, full-size, with a million circulation; the *Herald Tribune*, full-size, with about three-quarters of a million circulation, and the *Mirror*, a tabloid, with close to 2 million circulation, all published very large editions on both Sundays, while all of the daily editions, including the *World-Telegram*, with a daily circulation of well over a half million, have come out in king-size daily since the strike ended. Also in the metropolitan area, the newspapers published in Brooklyn, Long Island, Staten Island, Westchester County, and Northern New Jersey were of much larger size.

Medical Education

T. N. Bland, president, Fibreboard Products, has accepted the chairmanship of the Paper & Paper Industry Div. of the Committee of American Industry, Colby M. Chester, national CAI chairman and honorary chairman, General Foods Corp., announced recently.



T. N. Bland, Fiberboard Products, Inc.

A division of the National Fund for Medical Education, the CAI is spearheading a nationwide appeal to raise $10,000,000 for the country's 79 medical schools. Mounting deficits are threatening not only the schools' teaching and research programs, but also their high academic standards.

In accepting the appointment, Mr. Bland pointed out that medical schools are an important national resource on which depends the "health, productivity, and security of the country." He emphasized that the financial struggle, brought about by mounting expenses and the shrinking income, is seriously imperiling their continued existence as independent institutions.

Bureau of Standards

The National Bureau of Standards has announced that Robert B. Hobbs has been appointed Chief of the Paper Section.

ODM

An Interdepartmental Forest Products Committee, one of several such committees which will serve in an advisory capacity to ODM, has been established by Defense Mobilization Order V-1, Supplement 1, December 4. The Forest Products Committee consists of one representative from each of the following agencies: Department of Defense, Department of Commerce, Department of State, Department of Interior, Department of Agriculture, U. S. Tariff Commission and General Services Administration. The committee will advise ODM's assistant director for materials in the develop-

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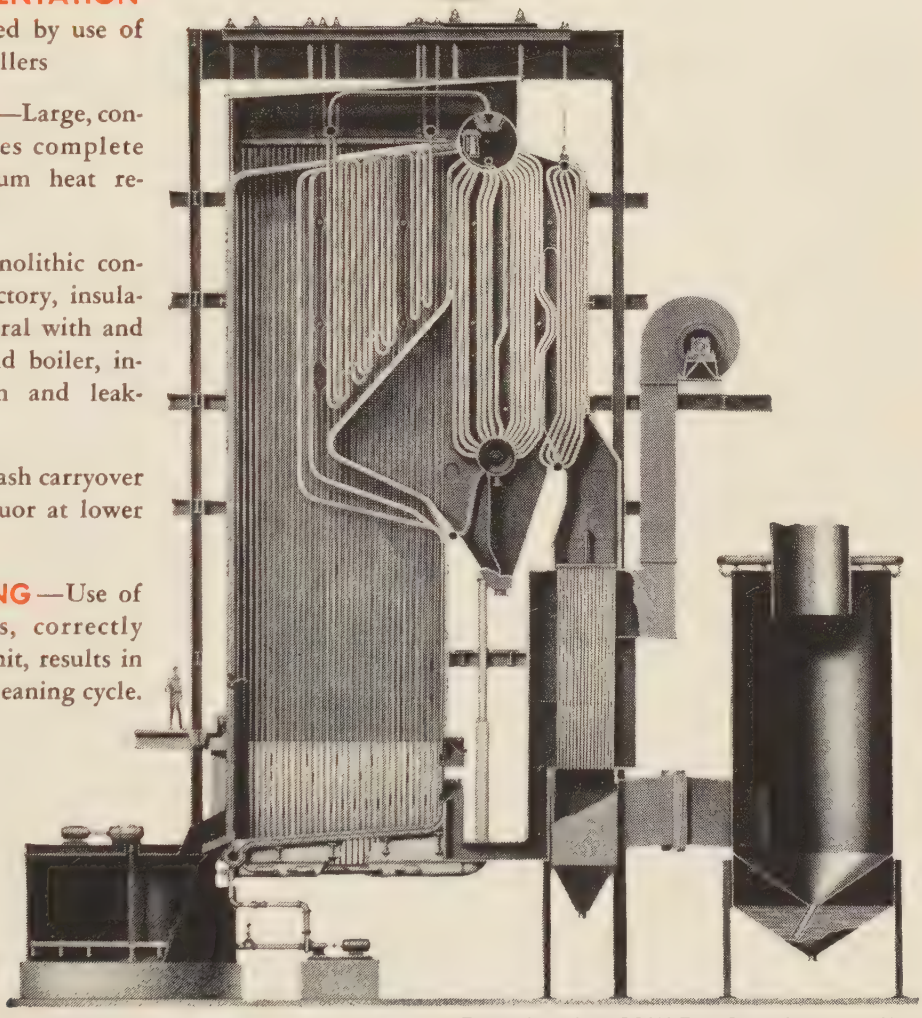

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ment of supply, requirements, and technical data. It is understood that ODM is continuing to give serious consideration to the creation of a division to handle agricultural and forest products.

APPA

The American Paper and Pulp Association filed, on December 15, two statements with the Citizen's Advisory Committee of the Senate Banking and Currency Committee, appointed by Senator Capehart. One statement sets forth the Association's position with respect to the sale of publicly owned forest resources in Alaska to foreign interests, and the other, the viewpoint of the pulp and paper industry with regard to the operations of the Export-Import Bank, the International Bank for Reconstruction and Development, as well as related activities of the Foreign Operations Administration.

The statement on Alaska was prompted by the fact that the United States Government has under consideration a plan whereby the Government would sell wood harvested from publicly owned land in Alaska to Japanese interests and that these interests, under the cloak of an American corporation, would use this wood to produce dissolving pulp for shipment to Asia.

The second statement considers the operations of the Export-Import Bank and the International Bank for Reconstruction and Development in the light of whether their operations have resulted in creating serious competition to our domestic industry. The Association recommended a restricting of the lending policies of these two agencies, as well as industry consultation on specific loans for the development of foreign pulp and paper industries.

Foresight

Although its press run was only a few thousand at the time, some unidentified executive of the Chicago *Tribune* had the foresight in 1861 to express in the paper's articles of incorporation the right "to manufacture paper and purchase and hold as much real estate and waterpower as necessary . . ."

No advantage was taken of that right until 52 years later. Then Robert McCormick became head of the *Tribune* Company. Almost immediately he asked for a million dollars to build the paper's own newsprint plant in Canada. Reluctantly, the board of directors voted the money.

Mr. McCormick, a lawyer who had previously been head of the Chicago Sanitary District, had figured that the population would reach $4^1/_2$ million by 1950. It actually reached 4,508,792. The 31-year-old newspaper head had foresight. He anticipated the growth in circulation. The *Tribune* then had a circulation of about a quarter of a million. He was sure it would reach half a million.

Nearly everybody knows that no other paper has reached the *Tribune* in combined circulation and power in its territory. Ownership of its paper supply has enabled it to meet competition. It has achieved success because Col. McCormick believed in his country and was sure it would grow, and also because he had foresight to prepare his company to meet increased demands.

Drupa

The next German International Fair on Printing and Paper will be held at Dusseldorf, Germany, on May 15–30, 1954.

Rapid Tax Write-offs End

The Office of Defense Mobilization has announced that it has abolished rapid tax write-offs for wood pulp, paper, paperboard, and newsprint mills and that accelerated tax amortization certificates will not be issued for these closed goals on applications filed after December 3. Processing of applications already on file will be completed.

Foresters' Employment

A new review of foresters' employment shows 6200 foresters in private employ in the United States. The trend of increasing employment of foresters in private industry, begun shortly after World War II, continues at a high level.

A joint analysis of the forestry situation by the Society of American Foresters and the American Forest Products Industries, Inc., reveals the following estimated distribution of foresters in the various classes of employment:

Federal, all agencies, 4800; state, all agencies, 1500; county and municipal, 200; education, including extension and institutional research, 700; private, including industrial, 6200, and unclassified, including allied fields, 1600; total 15,000.

Over 41% of all the professional foresters are estimated to be privately employed. This category includes about 5000 employed by industries, 1200 self-employed, consultants, managers of nonindustrially owned woodlands, and association foresters.

South Olympic Tree Farm

Simpson Logging Co., acting on the recommendations of its chief forester, George Drake, organized South Olympic Tree Farm in 1943. Within a few months, Simpson was joined by the Weyerhaeuser Timber Co. and the Milwaukee Land Co. in the formation of a nonprofit organization incorporated as the South Olympic Tree Farm Co.

The participating companies and later members, one owning only five acres, listed 140,000 acres under management of South Olympic Tree Farm in 1943. The original acreage has been enlarged to over 176,000 acres under management within the present boundary area of 350,000 acres in eastern Grays Harbor County, western Mason County, and northwestern Thurston County.

The first objective in setting up South Olympic Tree Farm was effective fire protection for the blanket of second growth on thousands of acres which had been logged as early as 1890. This called for developing a network of roads from which fire suppression crews could reach any danger spot. It called for organizing a fire protection system of radio, telephone fire lookouts, and weather stations which could cooperate with all other industry and public agencies in the area.

It called for enlisting the help of the public in keeping alert to fire dangers. This was at a time when fire in the woods was so common that people took it for granted. For decades, men had burned trees to clear land. That was considered the way to get rid of what was then called brush.

The reward for all of this effort has been South Olympic's remarkable 10-yr. fire record. In that time, only 14 fires have originated on, or burned on, tree farm lands with a total burn of 64 acres. Seven of these fires were from lightning; seven were man-caused. The largest, caused by a house fire which spread into timber, burned over 32 acres of fully stocked 30-yr.-old Douglas fir.

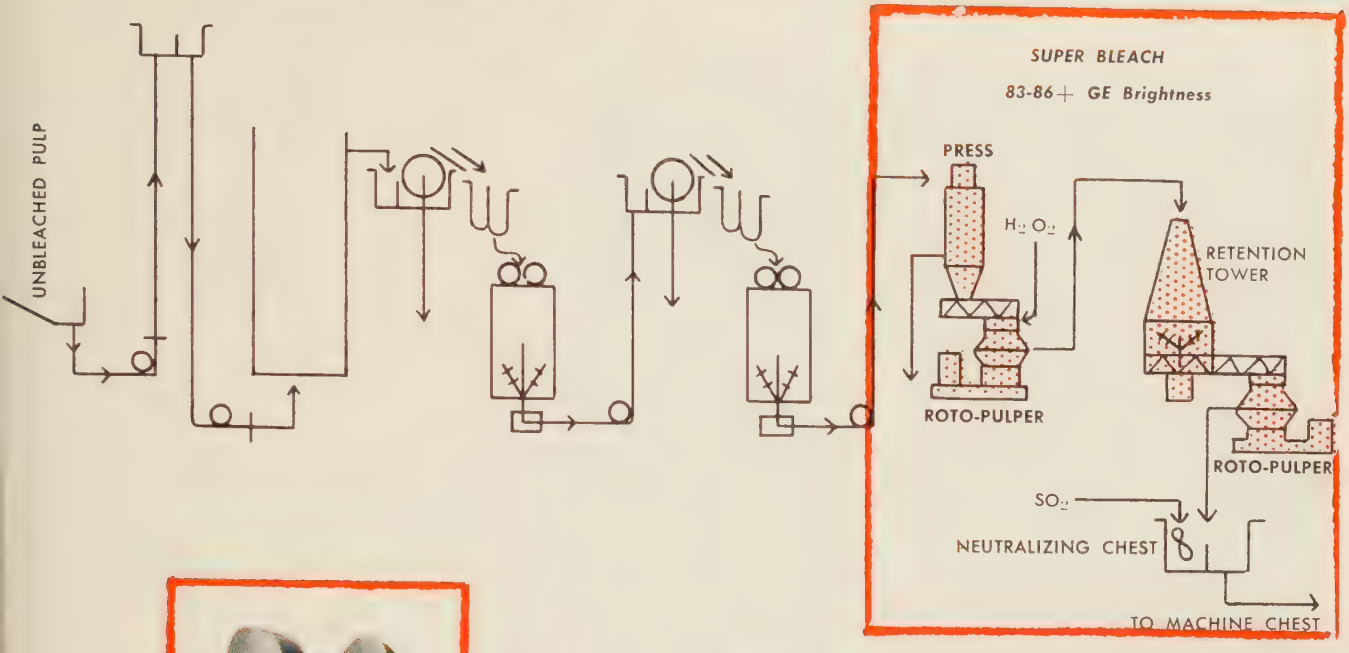
The average annual loss on South Olympic Tree Farm has been less than $^1/_{200}$ of 1%.

To supplement its fire protection, South Olympic has built 160 miles of protection roads giving access for fire protection, tree planting, and general administration. Most of the road mileage has been opening up and converting old logging railroad grades into truck roads.

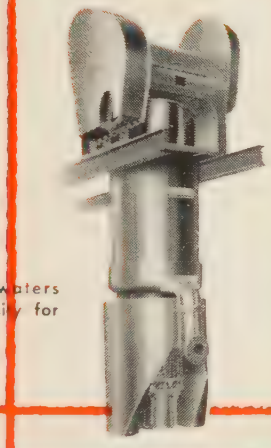
As a source of water supply during the dry "fire months," the tree farmers have developed 70 water holes at springs, small streams, and in swamps. Bulldozers have diked to form reservoirs and beavers have been great helpers in making a network of natural water holes in remote spots.

The tree farm has erected its familiar railroad iron protection gates at points where fire closures are necessary during seasons of high hazard. But it has always been South Olympic's policy to open these gates to hunters and fishermen

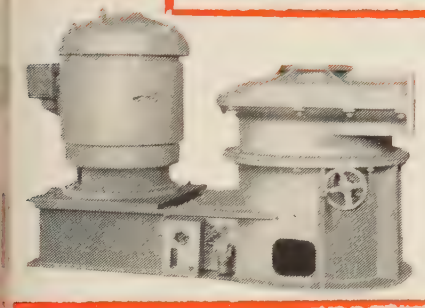
GET HIGHER BRIGHTNESS



through SUPER bleaching!



enith press dewaters
lp to high density for
each mixing



015 Roto-Pulper serves as bleach mixer, second Roto-Pulper as a denodulizer.

A PREMIUM PULP . . . GREATER PROFITS . . . PLUS THESE ADVANTAGES: ECONOMICAL—lower chemical, steam and power costs. LOW CAPITAL COST—only one extra stage of high density required. SAFE—no damage to pulp physicals . . . yield retained . . . no reversion.

From a semi-bleached pulp with a brightness of 71-73 GE, most pulps can be readily superbleached to 83-85 GE with one extra stage (above) using peroxide at high density. Under favorable conditions brightnesses approaching 90 GE can be obtained.

Advantages of high density bleaching and some of the inherent problems, including difficulty of introducing and distributing bleach at a uniform rate and eliminating nodules or "knots", have long been recognized. *(See "Manufacture of Pulp and Paper", pp 855-6, para. 28 and p 878, para. 51.)*

Now both of these obstacles have been removed with development of the Jackson & Church Roto-Pulper. Three years' plant experience proves conclusively that Roto-pulpers successfully mix bleach in desired quantities on a continuous basis and remove troublesome nodules.

With these problems solved, the industry now can take full advantage of high density bleaching and its inherent features.

Our engineers are ready to assist with your paper and pulp processing problems. Write to Zenith Division, Dept. T.

JACKSON & CHURCH CO. SAGINAW, MICHIGAN

J-C

Work well done since eighty-one

and berry pickers during their seasons to the limit that weather will permit.

Since 1943, the Tree Farm has been "catching up with the loggers," by reforesting manually lands which have failed to reforest naturally. In this time it has planted nearly 11 million trees on 17,000 acres. Costs of planting have jumped from $11.83 per acre in 1943 to $21.13 this year, but the program has moved forward without a flinch.

One of the significant developments at South Olympic's headquarters camp is the seed extractory, which, since 1949, has threshed over 12,000 bushels of cones to provide seed for the Pacific Northwest forest industry. Species processed include Douglas-fir, Sitka spruce, western hemlock, western red cedar and white fir. Cleaned seed recovered from a bushel of cones varies from four ounces to a pound.

The South Olympic extractory has produced only certified seed since 1949, and its output has created calls for seed from interested forestry organizations all over the world.

South Olympic Tree Farm's influence has been felt throughout the region. It has produced employment for hundreds of seasonal planters, cone pickers, and minor forest products workers. It has been the "father" of ten smaller tree farms in Mason County and has influenced the 4-H tree farm growth in Grays Harbor and Mason Counties.

Northeastern Forest Experiment Station

The Northeastern Forest Experiment Station of the Forest Service, U. S. Dept, of Agriculture, Upper Darby, Pa., has issued the following publications: "How Second-Growth Northern Hardwoods Develop After Thinning," by Robt. W. Wilson, Jr., "Forest Statistics for New York Forest District No. 3" (Central New York), "Five Years of Research on the Fernow Experimental Forest, West Virginia," and "Notes on Flowering and Fruiting of Northeastern Trees," by Jonathan W. Wright.

Woodlot Conference

The proceedings of the National Farm Woodlot Conference, held at the Conrad Hilton Hotel, Chicago, Ill., June 25 and 26, 1953, have been published by American Forest Products Industries, Inc., 1816 N. Street, N. W., Washington 6, D. C.

Kentucky

Timber growth exceeded timber removal by more than 65% in Kentucky in 1948, according to a report just released by the Central States Forest Experiment Station of the U. S. Forest Service.

The growth of sawtimber exceeded the cut and other losses by 455,000,000 board feet, the report points out. It also estimates the sawtimber volume could be doubled with good management and protection.

"Kentucky's Forest Resources and Industries" covers the results of nearly three years of field study.

Maine Forest Tax

"The general property tax often imposes an inequitable burden on properties devoted to the continuous production of forest crops. Usually such burdens are the result of improper assessments or unreasonable tax rates, or both. Wherever burdensome conditions exist, the general property tax should be modified in its application to forest properties, or superseded by a more equitable system of forest taxation." This statement appears in *A Proposed Program for American Forestry* worked out in June, 1953, by the American Forestry Association at its Higgins Lake, Mich., conference.

New Hampshire provides an outstanding example of pioneering efforts to overcome the handicaps to good forestry inherent in traditional methods of property taxation. Under New Hampshire's new law, owners of forest properties pay annual taxes only on the value of the land itself. They are taxed on timber values only when they make cuttings. The 10% "yield tax" is reduced to 7% of the value of the products removed if the cutting complies with approved forestry practices. Like many new devices, this law is probably not yet in final form, but it shows strong promise of assuring forest owners of equitable taxation and thereby enlarging the extent of good forest management.

Many citizens of Maine have long been aware of the desirability of modifying the state tax laws to encourage wider application of good forest management practices. Wood-consuming industries are important contributors to Maine's economic activity.

Forest taxation in Maine differs from that of the other New England states because of the existence of a unique situation. Unlike the other states, a little more than half of Maine's 16 million acres of forest land is in unorganized towns in which taxes are assessed and collected directly by the state. Because of traditionally conservative taxing policies, a uniform tax rate, and a consistent method of assessment, taxes have not caused practical difficulties in the management of forest properties in the unorganized towns. On the basis of many years of experience, owners of such properties can proceed with plans for scientific forest management without fear that an excessive proportion of their earnings will be taxed away. The average annual forest property tax in the unorganized towns has been, in recent years, in the neighborhood of 11 or 12 cents per acre. No public services are rendered in this area. There are no public roads or schools. Where such facilities exist they are built and maintained at private expense.

In the organized towns, on the other hand, where taxes are administered by local authorities, a condition has existed similar to that in most of the rest of New England. There has been no uniformity in tax rates, no consistency in the method of assessment, nor any assurance of a sound taxing policy. While it can be argued that forest property taxes have not, in the main, been excessively burdensome in the organized towns, the record shows individual cases of annual taxes amounting to as much as $1.50 and higher per acre. There are reasons for believing that even the threat of over-taxation is an effective deterrent to long-range planning for forest management.

As they contemplated their forest taxation problem, the people of Maine were aware that changes are needed if the growing of timber as a crop is to receive needed encouragement in the organized towns. It was believed necessary to devise legal action that would meet the need in the organized-town portion of the state as well as in the unorganized territory.

With this background, the late Senator Edward E. Chase of Cumberland undertook the responsibility, as chairman of a subcommittee of the legislative research committee, of drawing up proposed legislation to provide Maine with a forest tax law suited to its needs. After several years of exhaustive research, and two public hearings before the legislative research committee, Senator Chase introduced into the state legislature, in January, 1953, a bill which he believed would offer the best chance of solving the problem. The legislature passed this bill, with some modification, and it became effective on Aug. 8, 1953. It differs substantially from the law adopted in New Hampshire, insofar as the taxing method is concerned, despite the fact that the philosophy and purpose underlying the two laws are practically identical.

Instead of abolishing the annual tax on standing timber and replacing it with an entirely new method of tax assessment, with a built-in incentive to good forestry practices, the Maine law merely proposes a change in the method. It says, in substance, that the annual tax must not be excessive and that there must be uniformity, by criteria it establishes, in the assessment. The sections of the Act, in which the amending legislation is incorporated, read as follows:

"*Policy.* It is hereby declared to be the public policy of

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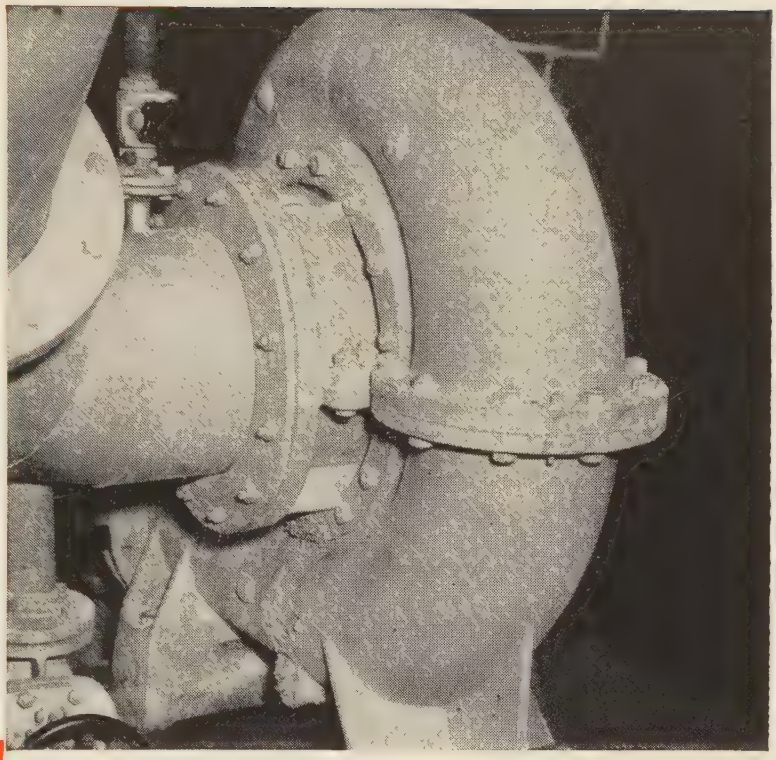

BEATER SWELLING

FOAM AT THE SCREENS

FOAM IN THE HEADBOX

FIBER FLOCCULATION

STOCK PUMP BINDING

FOAM IN THE WIRE PIT

FOAM IN THE VATS

FOAM AT THE SAVE-ALL

FOAM AT THE MIXING BOX

FOAM AT THE SEAL BOX

FOAM SPOTS IN THE PAPER

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For low foaming—high efficiency standardize on MERSIZE

To reduce stock pump binding—and cut down foam troubles at ten other vital points – use new *low-foaming* Mersize. From beater to finished paper, Mersize will help you lick problems commonly caused by sizes with a high foam index.

Mersize has other important advantages, too. High sizing efficiency and low sizing cost combine with low foaming to make Mersize standard in mills that insist on the best available sizing agent.

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the state, by which all officials of the state and of its municipal subdivisions are to be guided in the performance of their official duties, to encourage by the maintenance of adequate incentive the operation of all forest lands on a sustained yield basis by their owners, and to establish and maintain uniformity in methods of assessment for purposes of taxation according to the productivity of the land, giving due weight in the determination of assessed value to location and public facilities as factors contributing to advantage in operation.

"*Assessment.* An assessment of forest land for purposes of taxation shall be held to be in excess of just value by any court of competent jurisdiction, upon proof by the owner that the tax burden imposed by the assessment creates an incentive to abandon the land, or to strip the land, or otherwise to operate contrary to the public policy herein declared. In proof of his contention the owner shall show that by reason of the burden of the tax he is unable by efficient operation of the forest land on a sustained yield basis to obtain an adequate annual net return commensurate with the risk involved."

Local tax assessors will be in compliance with the new law only when they base their assessment on the productivity of the land in question rather than, as heretofore, on the value of such standing timber as it may happen to have on it at the time. The law presupposes the establishment and continuation of a condition under which there shall be a fair relationship between the tax and the net return received from the operation of the land on a sustained yield basis. Involved risk is to be considered. The owner's operation must comply with some standard of efficiency. A tax payment will be due each year regardless of whether the owner receives income from the property.

How good is this new Maine tax law? Is it as good as or better than the New Hampshire law? The answers will have to await the test of time. Both laws have a worthy common purpose. Both are the result of the study and effort of people of high competence to deal with the problem. The principle on which they are based is sound in both cases. Exact comparison will probably never be possible because of differences in conditions under which they will operate. The prospects that the Maine law will be successful and achieve its purpose will be in proportion to the support and understanding it receives from all those concerned with its operation. Putting the Maine law into operation will not be a simple task but the simplicity of its purpose may stand in its favor.

Finland

Finland is now starting to put into operation a program for converting more timber and pulp into paper and board products. During the past two years, new mills and new machines have started producing kraft liner, kraft paper, and various board qualities.

Two new mills are now under construction for newsprint. The buildings are largely completed for the new United Paper Mills newsprint plant in south central Finland, and production from the first machine is expected in August, 1954. This American made machine will have a 270-in. trim. The second machine is expected to come into production during the second half of 1955 as reported by *Paper Mill News*, November 28.

Enso-Gutzeit, Finland's largest concern in the woodworking industry, is now constructing a new newsprint mill at a tidewater location, and although the program will ultimately be a two machine mill, only one unit has been ordered. This machine will have a 256-in. trim and should come into production in 1955.

By the end of 1955, Finland will have added 255,000 tons annually in new production. It has been Finland's long range policy to sell about 40% of her total newsprint exports to America.

In order to ease the difficulties of wood pulp producers, the Finnish government has introduced a bill providing for the repayment to the wood pulp industry of half the amount (FMK 8.33 billion—U. S. $36,217,000) that the industry paid in price equalization levies in 1951 and 1952. According to the present laws these levies were not to be repaid until 1954–56. If the bill is approved, repayments would start in the fourth quarter of 1953. They would amount to FMK 3000—U. S. $13 per ton for chemical pulp produced, and FMK 2000—U. S. $9 per ton for mechanical pulp. It is assumed that at least 240,000 tons of chemical and 175,000 tons of mechanical wood pulp will be produced in the fourth quarter.

The repayments will be increased by whatever percentage total production in the quarter exceeds the specified minimum quantities. If during any quarter of 1954, the export price is higher than the export price during the fourth quarter of 1953, the amounts repaid will be reduced correspondingly.

Norway

The outlook for Norway's forestry products is moderately good. The pulp industry has practically sold all of its 1953 production and some factories have sold part of their 1954 as well. Prices are stable at a satisfactory level, and in the chemical pulp market they have risen somewhat. Chemical pulp factories are running at about 80 to 85% of capacity. Mechanical pulp production remains below the 1951 peak level.

New Zealand

Press reports from Washington state that the long-pending New Zealand request for an Export-Import Bank loan should be settled one way or another, within a few weeks. New Zealand wants up to $20,000,000 to help finance an $85,000,000 lumber, pulp, and paper mill project. The Export-Import Bank has been negotiating with private lenders since last Summer. A special loan investigation mission that the bank sent to New Zealand in November will return shortly to report.

Australia

The latest statistics issued by the *Commonwealth Statistician* show that there are now 16 pulp and paper mills in Australia, employing at the end of the financial year, 7237 workers. Salaries and wages paid during the year totaled £5,852,000 (current value of pound is $2.24). Total value of materials used was £14,559,000, while power, light, fuel, etc., cost a further £1,610,000. Value of output was £28,792,000 while production (output minus cost of raw materials, containers, power, fuel, light, water, etc., and representing the value added in course of manufacture) was worth £12,623,000.

The industry is operating in all states, but is chiefly centered in New South Wales, Victoria, and Tasmania stated *The World's Paper Trade Review*, November 19. Eight of the plants are in Victoria, three in Tasmania, two in New South Wales, and one in Queensland, in South Australia and in Western Australia.

Pulp plants, producing pulp from eucalypt timber, are operating in Tasmania and Victoria, while pulp is being produced in South Australia from locally grown softwoods.

Paper mills in Tasmania are engaged in the production of newsprint, writing, and printing papers, while mills in other states are producing boards, wrappings, and other papers.

Value of land and buildings was £7,530,989 while plant and machinery was worth £15,365,089. Additions to land and buildings during the year cost £2,341,146 while additions and replacements to plant and machinery cost a further £5,188,564.

Average annual salary and wage per employee was £809; average value of output per person engaged in the industry was £3987; average value of production per person was £1744, and ratio of salaries and wages to value of production was 46.36%.

Quit working so hard!

HERE'S the *Quick-Clean-Easy* way to add paper-aid!

take one of these bags

slash it 2 or 3 times

throw bag and all in the beater!

No time lost!
No spillage of Dicalite!

You can do it because DICALITE BP-5 and DICALITE BP-3 are now available packed in bags made of bleached white sulphite! No colored stock of any kind – no string sewing – even the ink of the small label is water-soluble. Just top-quality paper-aid and high brightness pulp in one easy-to-handle package, at a very small extra charge.

Paper-makers like this new packing of the Dicalite paper-aids which have proven so valuable in paper mills throughout the country. Some of the advantages reported by users:

- Improves sheet formation: good bulking, added opacity, increased whiteness, better printability.
- Increases board liner coverage.
- Speeds drainage and drying . . . permits faster machine speeds.
- Saves pulp and titanium.
- Excellent in pitch, wax and asphalt control.

In other words, ***production is increased, costs go down, product is improved!***

Dependable GREAT LAKES *Dicalite*® DIATOMACEOUS MATERIALS

Dicalite Division • Great Lakes Carbon Corporation • New York 17 • Chicago 1 • Los Angeles 17

In pulp mills, 452,955 tons of wood was used to produce 100,847 tons of chemical and mechanical wood pulp.

In paper mills 152,929 tons of pulp, 11,718 tons of straw, and 94,528 tons of old or wastepaper was used, and articles produced included: 32,648 tons newsprint; 502 tons blotting paper; 2516 tons duplicating paper; 29,817 tons printing and writing paper; 35,301 tons kraft wrapping paper; 2500 tons other wrapping paper; 13,866 tons other paper; and 4005 tons felt and carpet felt. Production of straw and other boards was 115,902 tons.

Nova Scotia

The first organized survey of Nova Scotia's industrial potential will be undertaken soon to relate natural resources to directly specific new industries. The survey is expected to start early next year, and will tabulate every phase of Nova Scotia's potential, including man power, sources of fuel and power, marketing possibilities, existing industries, plant locations, availability of investment capital and other factors pertinent to industrial development. The survey, sponsored by the Provincial Government's Department of Trade and Industry will be conducted by Arthur D. Little, Inc., Cambridge, Mass.

Fiskeby Fabriks

The new paperboard mill of Fiskeby Fabriks Aktiebolag, Norrkoping, Sweden, is the first American-type folding boxboard mill ever built on the Scandinavian-Peninsula that will extensively utilize waste furnishes in the production of high-grade boxboards for industry in Sweden and adjoining countries.

Designed to ultimately produce 200 tons per day the new Fiskeby mill is almost completely Black-Clawson equipped. The 140-in. trim seven-cylinder Black-Clawson board machine features overhead primaries, a double-deck drier section, two calenders, a uniform speed reel, a Jagenberg winder and cutter-layboy, and a newly designed Black-Clawson smoothing press. Hydronamic inlets are employed on liner vats.

The four-stock stock preparation system supplied jointly by Shartle Bros. and Black-Clawson International Ltd., London subsidiary of Black-Clawson features Hydrapulpers, Hydrafuges, and Duo-cycling. Hydrapulpers provide effective pulping of all four stocks. The filler stock cleaning system features Hydrafuge separators as the principal stock cleaning units to remove foreign material from the filler stock prior to the thickening and jordaning. A new Duo-cycling system provides completely automatic, remotely controlled refining of liner stock. Hydrafiners equipped with Duotrol, automatic plug adjusters are the principal components of the automatic Duo-cycling system. Four Miami No. 2A jordans presently comprise the jordaning element of the entire system.

The papermaking equipment at the new Fiskeby mill was started up under the supervision of W. A. White, and J. H. Pearson of Black-Clawson Co., and American consultant, Robert Stevens, on Nov. 19, 1953. Salable paperboard was produced on the first attempt. The mill went into daily production on test liner on November 24, and according to latest reports, no operating difficulties have been experienced.

Israel

The first modern paper mill erected in the Middle East was officially opened Dec. 17, 1953, by Acting Prime Minister Moshe Sharett of Israel.

Constructed at a cost of $4,000,000, the American-Israeli Paper Mills, Ltd., plant is located on a 22-acre site midway between Tel Aviv and Haifa and can meet all of Israel's paper requirements.

The mill was put up by Joseph M. Mazer, Treasurer of the Hudson Pulp and Paper Corp., New York; the Palestine Economic Corp., New York, largest American development company in Israel; and other American, foreign, and Israeli investors.

Seven hundred Israeli business leaders, as well as top officials of the Israel government, including Labor Minister Golda Myerson and Minister of Trade Peretz Bernstein, inspected the plant.

The mill houses a 1000-ft., $800,000 papermaking machine purchased in Scotland, which is the largest single machine in the country. Merritt-Chapman & Scott Corp., of New York, noted American engineering construction firm, was in charge of planning and erecting the factory, which took 18 months to complete.

The mill will produce approximately 15,000 tons annually of newsprint, writing, and kraft papers. A number of expert papermakers from the United States, Scotland, and Switzerland are working in the mill, training Israelis who will carry on their duties.

The mill is expected to save Israel $1,000,000 annually in foreign currency.

Pakistan

Newsprint

The economic feasibility of setting up a newsprint plant in East Pakistan will be studied by a United Nations expert who left Switzerland for Pakistan on Dec. 15, 1953.

The expert, who is being sent by the United Nations Technical Assistance Administration, to advise the Pakistan authorities on this project, is Fritz Hosli, a Swiss consultant with extensive experience in the paper and pulp industry.

East Pakistan abounds in a superior species of tropical softwood believed to be suitable for use as pulp for making paper and mechanical coated printings. This wood has been tested in Sweden with satisfactory results. Also a preliminary survey of the raw material situation has been made by an expert provided by the Food and Agriculture Organization. However, before proceeding with the setting up of a plant, the Pakistan government has invited the United Nations expert to advise on the feasibility of the proposition.

The government believes that, should it prove possible to go ahead with the project, it would result not only in a better utilization of the forest resources but also in the creation of a good exportable commodity. The project is being initially developed by the Pakistan Industrial Development Corp.

Specifically, the United Nations expert will make a more detailed technical evaluation of raw materials available in Pakistan; will scrutinize the methods and processes proposed to be adopted for the pulping of available tropical softwoods and conversion into paper; and will assess the economic feasibility of the project. Mr. Hosli has also indicated that he is interested in examining the potentialities of utilizing the many rivers of Pakistan for the water transport of wood for pulp manufacture, a lack of transport facilities being one of the country's acute problems.

Forest Products Laboratory

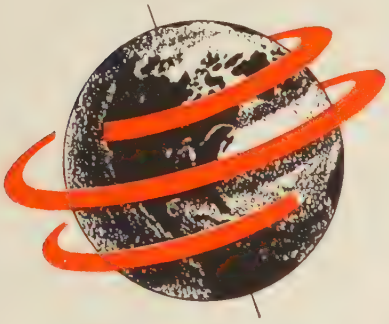
Laurence V. Teesdale, research engineer and architect at the U. S. Forest Products Laboratory, has returned from an assignment in Pakistan, where he helped lay out a new forest products laboratory and sawmill at Chittagon as part of the Point Four Program under the U. S. Foreign Operations Administration.

The new forest products research laboratory, to be built by the provincial government of East Pakistan, will include lumber dry kilns, a wood-preserving plant, a wood-chemical plant, and equipment for the manufacture of veneer, plywood, fiberboard, and hardboard from local materials. The director will be Q. Ghani, Pakistan Divisional Forester, who recently completed a training period at the U. S. Forest Products Laboratory.

The sawmill will have a capacity of 15,000 tons of logs a year, with a future capacity of about 40,000 tons.

The forestry project is part of an over-all plan to develop

Over 750 Installations
in 22 Countries
Throughout the World



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EACH MILL'S requirements suggest various applications.

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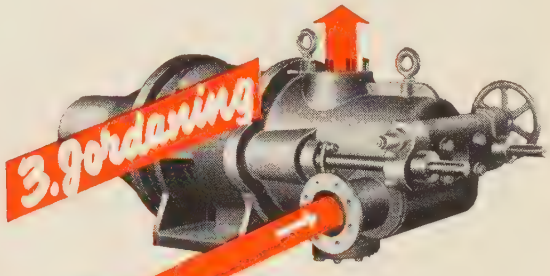
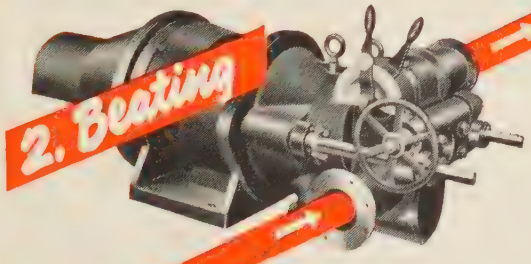
MORDEN SLUSH MAKER®

...for completely defibering all pulps, papers and brokes (even wet strength) without auxiliary equipment.



MORDEN STUFF MAKER

... for cutting or shortening where required to obtain specific sheet properties.



MORDEN STOCK MAKER®

...for brushing, fibrillating and hydrating individual fibers for maximum strength development.

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STOCK PREPARATION EQUIPMENT
MACHINES COMPANY

CORBETT BUILDING PORTLAND, OREGON

Northeastern States Representatives:
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Midwestern States Representatives:
DAN B. CHAPMAN, Appleton, Wisconsin

Other Representatives in most paper-making countries.

industries and improve all phases of Pakistan's economy, according to Teesdale.

"Industrialization is sorely needed," he said. "Although it is predominantly agricultural, East Pakistan is so densely populated that there is not much room for farming. One area of about 500 square miles has 3000 people to the square mile. In all, there are 46 million people—roughly one third the population of the United States—in an area the size of Wisconsin, and much of it is heavily forested."

The principal forest covers 8500 square miles of hilly border land between Pakistan and Burma. It's a difficult area to harvest, according to Teesdale, because the hills are rugged and extremely steep.

All the woods are hardwoods, with the logs running 3 to 4 ft. in diameter. As most of these heavy logs are sinkers, they must be supported by bamboo for the 90-mile float downriver from the cutting area to the sawmill at Chittagon.

The most important species is gurjun, a dense wood that runs about 70 lb. to the cubic foot. Although lumber from this wood has a tendency to fuzz, it can be worked with very sharp tools and is suitable for the manufacture of furniture, Teesdale said.

There are many problems still to be licked. For example, the logs can be harvested 12 months of the year, but they can be floated downriver only 6 months of the year when the water is high. This means many logs have to be stored without much protection for 6 months or more, which often results in considerable deterioration. This problem will be partially solved by the use of fresh water storage tanks and will be eliminated in a few years with the completion of a dam that will maintain an adequate water level to float logs to Chittagon all year round.

As these problems are all solved, Teesdale believes, the forests will provide the provincial government of East Pakistan with a considerable source of income.

Bag Paper

Today North America is producing $2^1/_2$ times as much wood pulp as Europe. This is a complete change in the world production of pulp as in 1933 imports to this continent were 7 times as great as exports. Currently, North American exports are larger than imports. The growth in the United States wood pulp capacity can be attributed to the change in consumption during the last six years; the increase demand for paper shipping sacks is a decided factor in this change. Domestic consumption of products made from wood pulp has expanded so greatly that better than 10% of the annual wealth of the United States is based on this industry and its products.

Wisconsin

More than half a hundred sources of pollution on the Upper Wisconsin River above Stevens Point were cited at a recent hearing of the Wisconsin State Committee on Water Pollution. Twenty-four municipalities pour raw and treated sewage into this stretch of the river, and thirty-three plants ranging in size from crossroads creameries to pulp and paper mills release industrial effluents to the stream.

State testimony covered seven pulp and paper mills between Rhinelander and Mosinee. It pointed to substantial improvement achieved by the mills since the last previous state hearing three years ago. At the same time, state authorities indicated they would like further progress from some mills. All three sulphite pulp mills on the stream are processing or treating their spent liquor to reduce its use of dissolved oxygen in the river water.

J. M. Holderby, manager of by-products division of Rhinelander Paper Co., made his company's statement to the hearing. He testified, "Rhinelander's installation for manufacturing torula yeast from the wood sugar in spent sulphite liquor and evaporating the residue for sale or burning has cost about $1,000,000. It cuts the mill's sulphite pollution by almost 60%. Additional equipment to be installed next month will increase this figure substantially. These nevertheless remain experimental processes because they fall far short of being self-supporting. We still are not sure how much they will cost to operate. Any sulphite mill adopting these processes is taking a real risk of both its income and its capital."

Speaking for Wausau Paper Mills Co. of Brokaw, David B. Smith, president, testified: "Our mill pumps all of its spent sulphite liquor and wash water to a lagoon for soil filtration, and thus none of our liquor goes unprocessed to the stream. So far this year 40,000,000 gallons have been lagooned, and the total will pass 45,000,000 gallons by the end of 1953." State technical testimony showed that this lagooning, "has resulted in a significant decrease in the biochemical oxygen demand discharged. While the long-term effectiveness is yet uncertain, present indications are that stream conditions below this mill should improve."

Marathon Corp. of Rothschild told of pioneering by independent research Wisconsin's first practical process for removing oxygen-consuming elements from spent sulphite liquor. This process, started up in 1937, converts the lignin of the Rothschild mill's collectible liquor into a variety of products ranging from vanillin flavoring to oil well drilling supplies. Company investment in the process exceeds $3,000,000.

"For the past ten years we have spent more than $100,000 a year on research to find ways of utilizing liquor fractions formerly unused, and thus reduce still further the effects of sulphite on the stream" said a Marathon spokesman. "We have made appreciable progress in this direction, and our research budget shows we hope to accomplish a good deal more."

Minnesota

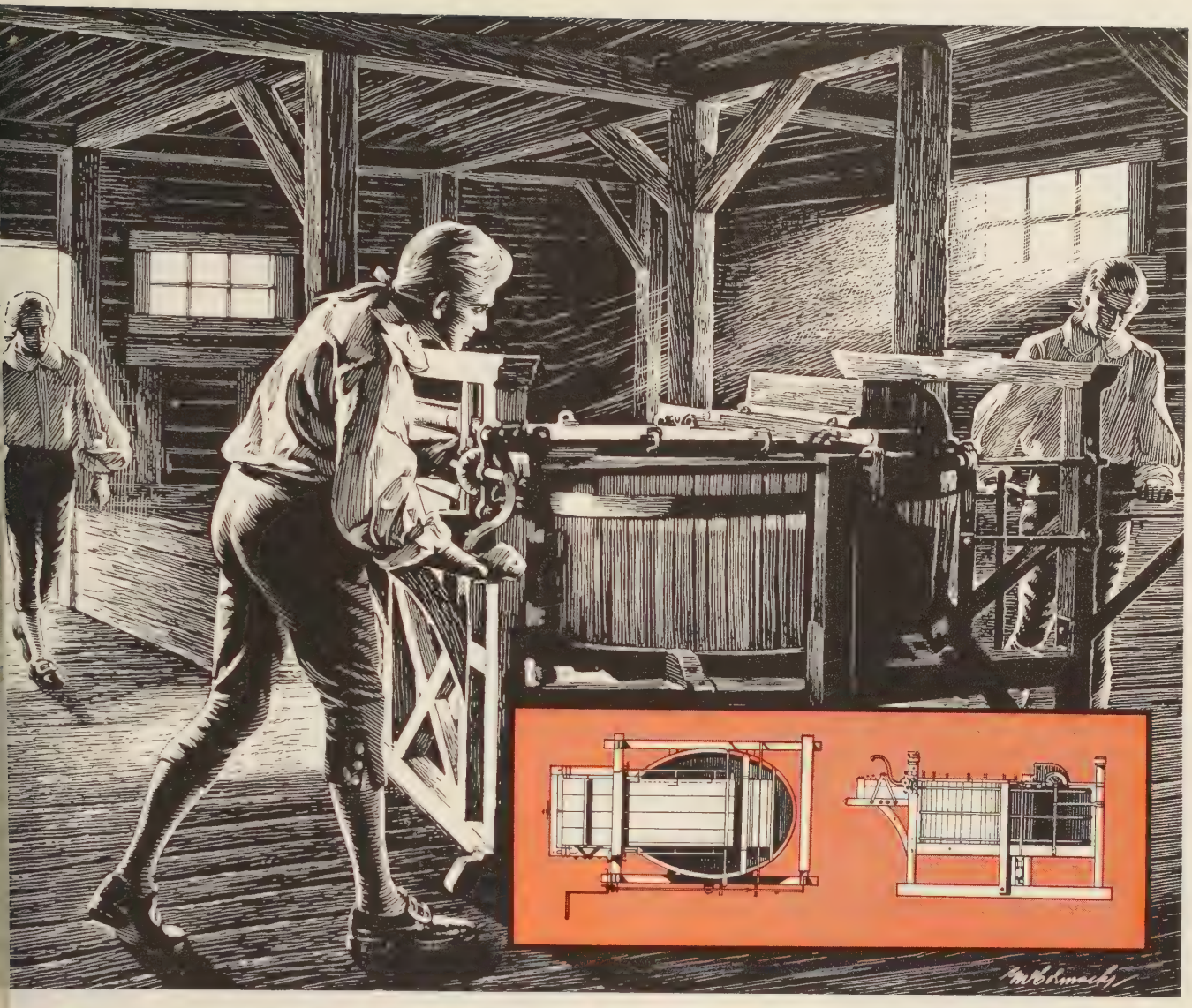
A pilot plant for producing a new-process veneer board is in final planning stages in Minnesota. It would use chopped aspen for core, thus opening up a new market for millions of acres of timber growth. Tentative location for the pilot plant, financed by a $350,000 state grant, is Bemidji.

Ohio

Robert Fulton steamed from New York to Albany in 32 hours in the first successful steamboat, Napoleon's armies occupied Berlin, Thomas Jefferson was in the White House, and Aaron Burr was tried for treason, when the first ream was produced in Ohio's earliest paper mill. Ohio had been a state for only four years with Chillicothe its first capital. The year was 1807.

On Aug. 1, 1806, an agreement was signed to build a mill near the mouth of the Little Beaver Creek, probably close to Fawcettstown in Columbiana County. This location is now East Liverpool. The signers of the contract were John Coulter of Brook County in Virginia, Jacob Bowman of Brownville, Pa., and John Beaver of George Town, also in Pennsylvania. Called "The Ohio Paper Mills" it probably had two vats producing a good quality of paper, size 13 by 16. The rags were selected and were given no detrimental chemical treatment. This mill used a watermark, a crudely designed eagle, its wings spread and with the inscription "OHIO"; beneath this appeared the initials of the three partners, CB&B. Two grist mills and one saw mill were not far from this early paper mill and, since these were doubtlessly equipped with water wheels, it would seem reasonable to assume that the CB&B Mill also employed water power. Total employment was about 30 persons. Construction costs for two to four vat mills at that time ranged between $3000 and $8000.

There were ten to twelve printing presses in the State at the time of this mill's opening and with the growth of population stimulated by the recently acquired Statehood, other



Papermaking Went Into High Gear With This Machine in 1798...

An important event in the history of papermaking was Nicholas-Louis Robert's invention of the paper machine over a century and a half ago. No longer would the slow methods of forming paper by hand limit size and quantity of paper sheets. Robert's machine formed paper of continuous length upon an endless woven-wire cloth which retained the matted fibers. Today more complex machines, operating on the same principle, produce a tremendous volume of paper. Helping maintain its quality are high-grade raw materials produced by A. E. Staley Manufacturing Company, supplier to leading mills for more than 30 years. Discover the many advantages Staley can offer *you*. See your supplier or write for details today.

Quality Staley® Products for Papermakers

Staley Sizing Starches
A full range of starches and dextrins for beater, surface and calender sizing.

Staley Corrugating and Laminating Adhesives
Corrugating starches, special laminating and bag adhesives.

Staley Coating Adhesives
Starches and Dextrins give better results for machine or regular brush coating.

Staley Plasticizers
"Sweetose"® and Staley's corn syrup are ideal softening agents for glassine paper.

PRODUCTS FROM CORN
Staley's

. E. Staley Mfg. Company, Decatur, Ill.

paper mills were soon established. One such mill was built by Frank Howells at Lockport. Converting from a flour mill, he made wrapping, newsprint and writing; the amount of paper produced was small, the prices high. Around 1810 Howell's daily production was between 100 and 150 lb. Chillicothe saw the foundation of its first mill between 1810 and 1812, at Kinnikinni Creek.

An interesting and very early establishment was the Waldschmidt-Kugler Mill also built in 1810 at Milford in Symmes Township in Claremont County. This mill lying on a bend of the Little Miami River only 16 miles east of Cincinnati, was probably the first in the Miami Valley region. Quite a bit is known about this mill, which is unusual, for records are meager regarding these earliest paper mills. This Milford mill was built by a young German immigrant papermaker, Christian Waldschmidt, who came to the United States in 1786 and practiced his trade first in Pennsylvania. Pioneering spirit urging him West, he constructed the Milford Mill with the assistance of John Smith, who became head vat man and dry loft boss. Construction lasted six months and a contemporary reference mentions the "difficult building of the huge overshot waterwheel." The mill was worked mostly by German immigrant workers and papermakers from Germany. One of these was Matthias Kugler who started there with a monthly wage of $8.00. Kugler soon became the mill owner's son-in-law, and special mention is made of this by Dard Hunter.

During an epidemic of 1814, Waldschmidt died, Kugler became master; thereafter the mill was known at Matt Kugler's mill. An early watermark was used here also, consisting of the letters W&C, beneath which appeared the word "MIAMI." Rags were bought for three and four cents a pound, wrapping and writing were made and production consisted of 100 to 150 lb. a day. Unsubstantiated reports have it that this mill was later mechanized, even to the point of having had an early fourdrinier. This would seem rather doubtful, however, in the light of the fact that the Waldschmidt-Kugler mill was closed in 1850 and the building converted to other uses.

—from *Ohio Tappi*, Dec. 11, 1953, by Ernest F. Barker

St. Regis

St. Regis Paper Co., New York, N. Y., announces that, effective Jan. 1, 1954, T. E. Button, vice-president of St. Regis Sales Corp., sales subsidiary of St. Regis Paper Co., is appointed sales manager for bleached and unbleached sanitary and specialty boards (including drum liner and can stock), and bleached cup stock and similar papers manufactured at St. Regis kraft mills at Tacoma, Wash., and Pensacola, Fla.

St. Regis also announces that Arthur B. Recknagel retired as technical director of forestry for St. Regis on Dec. 31, 1953. However, Mr. Recknagel will continue on a consulting basis. He will continue to assist in the scholarship program which the company has established in forestry.

Mr. Recknagel assumed his present position with St. Regis in 1947, after previous consulting work with the company. He has served as head of the Forestry Department at the University of British Columbia, Vancouver, B. C.; Area Forester of the U. S. Forest Service; and Professor of Forestry at Cornell University, Ithaca, N. Y. Mr. Recknagel is a member of the Council of the Society of American Foresters; and a member of the Forest Policy Committee and Forest Industrial Council of the American Pulp and Paper Association. He is also the author of forestry textbooks and articles.

Ohio Boxboard

Children of company employees will have an opportunity to go to college under a scholarship plan announced recently by Wayne Young, president of The Ohio Boxboard Co. The Ohio Boxboard Co. Foundation Scholarship Plan has been established as a significant part of the company's celebration of its 50th Anniversary.

The two winners of the yearly awards will receive $500 annually for four years while working toward any recognized academic degree. Once granted, the scholarship will continue in effect as long as designated personal and academic standards are maintained.

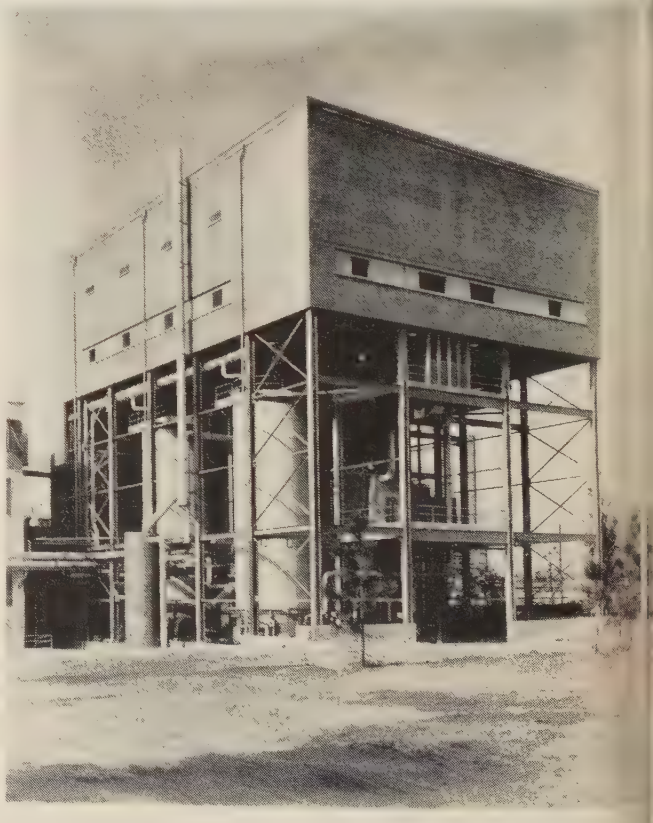
"We know," said Young, "that future progress in our community and our country will be made with leadership supplied from our present young people. By assisting outstanding students to develop along the lines of their choice, we are encouraging individual effort, and rewarding demonstrated merit. We are glad to be able to do this."

Any child of an employee with two years' service or any child of an employee who had five years' service immediately prior to death or retirement may make application for a scholarship. These candidates will be considered by a three-men committee including a college educator, an independent professional or business man and a representative of the company. Winners will be selected, after testing for scholastic aptitude, on a basis of ability, character, personality, and financial need.

Camp

Completion and start-up of the new bleach plant of Camp Manufacturing Co. at Franklin, Va., is the culmination of several years of careful study and planning on the part of the company combined with the efforts of its engineers, contractors, and equipment builders. The job of translating the aims and decisions reached in the various conferences into actual working plans and specifications was undertaken by the J. E. Sirrine Co., Engineers, in December, 1951. By early Summer, 1952, preparation of the site and the construction of foundations was in full swing. In September, 1953, the plant was completed, and testing and adjusting the equipment begun.

The ultimate program for bleaching, as presently conceived, will provide two complete and independent lines; one for pine, with a basic rated capacity of 250 tons per day of fully bleached pulp, and one line for gum, with a basic rated capac-



General view of the exterior of the new bleach plant at Camp Manufacturing Co.

UNIFORM PRODUCTION
MORE USE PER DOLLAR

MANHATTAN RUBBER COVERED ROLLS

anhattan Rubber Covered Rolls assure you of high-speed, uniform oduction. They won't crack, harden, corrugate or oxidize. An clusive Manhattan process provides an inseparable bond of rub- r to metal . . . eliminates separation of rubber cover from the etal core and reduces loss due to downtime.

stom-made to your specifications, Manhattan Rubber Covered lls give you permanent density and long, trouble-free service . . . lore Use Per Dollar" under all working conditions. Call an R/M ll covering specialist to discuss your requirements.

ROLL COVERING PLANTS AT PASSAIC, N. J. — NEENAH, WIS. — NORTH CHARLESTON, S. C.

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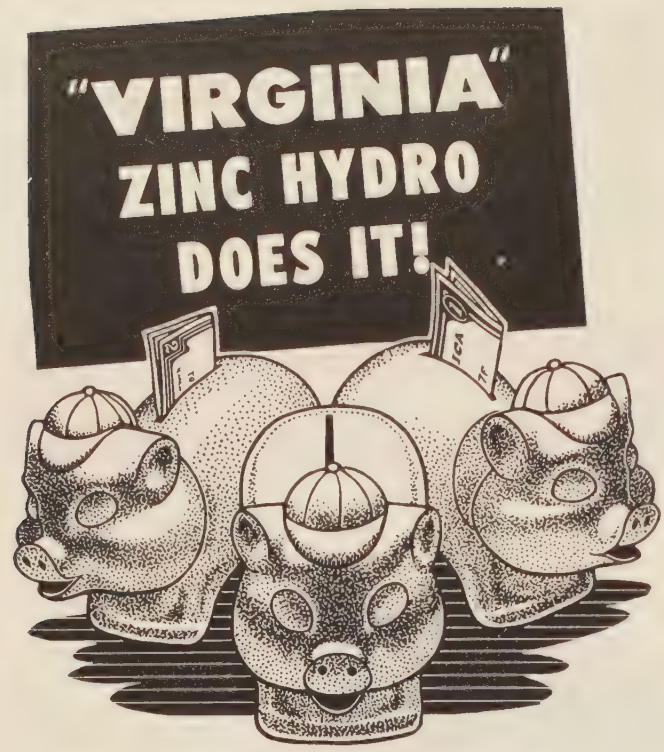
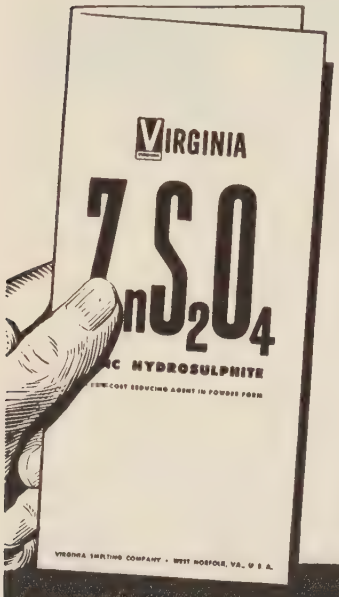


Three-Way Thrift

"Virginia" Zinc Hydro is widely used in the paper industry as one of the most *effective* brightening and decolorizing agents available for groundwood. "Virginia" Zinc Hydro is also one of the most *economical*. Please note the three important ways it contributes to economy: 1) its cost per ton of pulp is low; 2) the cost in capital investment of converting to its use is low; and 3) no auxiliary chemicals are required.



We urge your investigation of these economy claims for "Virginia" Zinc Hydro. When you find them to be soundly based, your interest in "Virginia" Zinc Hydrosulphite should be considerably whetted. Why not write today for a free test sample and our recommendations for its use.

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CHICAGO
ATLANTA

VIRGINIA Chemicals
SINCE 1898

ity of 100 tons per day of fully bleached pulp. With this ultimate aim in mind, the plant as now constructed and operated consists of two partly completed bleaching lines so arranged that their facilities may be combined to provide full bleaching for 250 finished tons of pine stock, or 100 tons of gum stock, or a combination of 150 tons of pine stock and 100 tons of gum stock. In all instances the gum and pine stocks will be treated in separate chlorination towers, but may be combined in succeeding stages.

The pine line, as presently constructed, consists of a low density chlorination stage, high density first caustic stage, high density first hypo stage, and high density second caustic stage. The gum line consists of a low density chlorination stage, a high density first hypo stage, and a high density second hypo stage. Construction of caustic stages in the gum line has been deferred for the present and the two hypo stages are used in parallel to provide, temporarily, a second hypo stage for the pine line. The towers in these two hypo stages are all-purpose towers suitable for either hypochlorite or chlorine dioxide bleaching.

Specifications and working drawings are under preparation at the present time by the J. E. Sirrine Co. for the installation of a chlorine dioxide bleach making plant under the Solvey process, with the conversion of the present final hypo stage to a chlorine dioxide stage; for which provision had been made in the initial plans but deferred until this process had been proved.

Building and Miscellaneous Structures

In view of the quality of product desired, every effort was made to secure the finest equipment and house it in a building befitting such a product. No expense was spared to provide the ultimate in control, cleanliness, convenience, good housekeeping, safe working conditions, and efficient operation. The building is constructed of steel, brick, and concrete, and occupies an area 75 by 117 ft. It is supported on more than 900 piles, 35 ft. long with a $3^1/_2$-ft. thick concrete cap. There are no exterior walls from ground to the operating floor, a distance of more than 60 ft., except a small room on the second floor used for bleach making. Two small enclosed areas in the center of the building house the unit substations and control centers.

From the operating floor to the roof, the building is completely enclosed with walls of brick and glass block. This enclosure houses the washers, instrumentation and electrical control panels, laboratory, stock meters, heating and ventilating equipment, and rest room. The instrument panels and laboratory at one end of the room are isolated from the washing area by tile and plate glass partitions.

In keeping with the policy of quality and cleanliness, the walls are provided with a buff-colored glazed tile wainscoting, and the floor surfaced with red quarry tile. A transite ceiling, with flush type fluorescent lighting fixtures, is suspended from the roof trusses. The attic space between the ceiling and the roof acts as a plenum chamber for the fresh air supply. Fifteen anemostat outlets are distributed over the washer room ceiling to provide proper ventilation.

Special care has been exercised to minimize or prevent humid or fume laden air coming in contact with electrical or control apparatus. Panel boards and operating consoles are continuously purged by an independent air supply. The motor control and unit substation rooms are likewise continuously swept by their own independent air supply system. Bleach making and chlorine handling rooms are each provided with their own independent exhaust fans. The principal ventilating system provides filtered air equivalent to six changes per hour in the washer room, panel room, and laboratory. An exhaust system, connected to all six washer hoods, removes approximately 5000 c.f.m. through each hood. The same exhaust system connects to each of the high density towers to prevent escape of steam and fumes into the building.

ll of the ventilating equipment has sufficient capacity to andle both bleaching lines when completed.

Carrying out the scheme of cleanliness and good house-eeping was borne in mind in choosing the interior paint. Valls above the buff wainscoting are painted white.

ower, Water, and Miscellaneous Utilities

Power to operate the bleach plant is delivered to the build-ng at 13,800 v. and transformed to 440 v. by three General lectric 1000-kva. high impedance unit substations. These re housed in the same rooms with the motor control centers, so by General Electric Co. One control room contains two nit substations and control centers for the motors driving umps, circulators, air compressor, and miscellaneous elec-ical equipment on the ground floor and lower half of the uilding.

The other control room houses one unit substation, control nters for driving mixers, ventilating equipment and other ectrical equipment on the upper floors. Also housed in is room are the package power supply units for the variable eed drives on washers and stock meters. These units and e d.c. motors they operate were furnished by Louis Allis Co.

Cold fresh water is supplied to the bleach plant directly om the pulp mill headers. A portion of this water is re-mped in the bleachery to furnish high pressure for the wire aning showers. Another portion is put through heaters provide hot water for washing showers. All water is tered.

Steam for heating the water and for heating the stock in the lp mixers is also obtained directly from the pulp mill aders. This is supplied through a single line provided with recording flowmeter by which the total steam consumed by e bleachery may be measured.

Compressed air for instrumentation is supplied by an gersoll-Rand 7 by 7-in. ES-1 compressor, complete with ercooler, receiver, and other accessories, installed on the ound floor.

each Liquor Making and Chemical Handling

Special spur tracks were built to accommodate chlorine and stic cars. Caustic is received as a 50% solution and

The chlorination towers

FOR LAMINATING

● PROXMELT 18-149-3. For combining foil, film, or glassine to boxboard. This Proxmelt has good compromise between adhesion, flexibility, and lack of penetration into the board. Moisture vapor impedance is excellent.

● PROXMELT 22. A viscous high temperature type laminating adhesive. The bond formed by this Proxmelt between foil and cork or paper is strong and flexible—and closes pin holes.

● PROXMELT 18-69-2. Where a sticky resinous bond between film or foil and paper or glassine is required, this Proxmelt is recommended. Molten viscosity is low enough to permit laminating on a waxer.

FOR COMBINING

● PROXMELT 30-104-4. A concentrate of butyl rubber in microcrystalline wax, this Proxmelt is used to up-grade adhesion and flexibility of all wax and micro type molten adhesives.

● PROXMELT 14-291-D. A molten type adhesive used to combine foil to paper, glassine, cork and scrim with heat and pressure. It is applied by hot melt machine technique, and requires quite high temperatures.

FOR HEAT SEALING

● PROXMELT 11. Applied to foil, and to tissue, paper, and glassine backed foil to render them heat sealing. Used on bag sealing lips, bag tags, tabs, labels, wrappers, etc.

● PYROXCOTE 23-144. This heat sealing plastisol was developed to produce a heavy coating where seals of great strength and flexibility are needed. Seals under relatively high temperature and pressure.

We'll be glad to furnish samples, and to consult with you on methods of using our products.

PYROXYLIN PRODUCTS, Inc.

CHICAGO 32

PAOLI, PENNA. WICHITA

Photograph by courtesy of the Champion Paper & Fibre Co.

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TO THE BEATER *to get:*

Better dispersion of ink, wax, etc.

More uniform hydration

Better lacing of fibers

Better retention of fillers

Reduced beating and jordanning time

Lower drying costs

Better control of slime

Improved absorbency

These are some of the improvements offered you by Magnus Beatex. Write for a copy of the Paper Mill Handbook to get the complete story.

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pumped from the tank car to storage tanks in the causticizing building. Automatic dilution equipment was installed adjacent to these storage tanks for reducing the strength of the caustic solution from 50 to 5%. Storage tanks are also provided in the causticizing building for the 5% solution, from whence it flows by gravity to pumps on the ground floor of the bleach plant. These pumps deliver the caustic to the hypo making room on the second floor and the pulp mixers in the caustic extraction stages. Consumption is metered and recorded. The portion delivered to the hypo making room is combined with chlorine to make sodium hypochlorite.

Chlorine is received in liquid form in tank cars and delivered to the bleach making room on the second floor by padding the car with dry compressed air. Since the flow of chlorine must be uninterrupted every precaution has been provided to assure a steady supply. Two tank cars are always on track and connected up, except during the short period required to remove an empty car and bring up a full one. Automatic signal devices warn the operators whenever the car from which chlorine is being drawn approaches the empty mark. Switching from one car to another is only a matter of seconds.

When the liquid chlorine from the car reaches the bleach making room, it passes through a steam-heated vaporizer where it is transformed from a liquid to a gas at a temperature of 110°F. The heated gas then passes through a regulator designed to maintain a constant pressure 50 p.s.i. in the supply lines to the process equipment. Various safety devices are provided to minimize the hazards of chlorine handling.

The equipment for continuous, automatic manufacture of sodium hypochlorite is housed in the same room with the chlorine vaporizing equipment. Here 5% caustic is combined with chlorine gas in the proper proportions to form the hypo bleach solution. Two structural glazed tile tanks, erected by Stebbins Engineering and Manufacturing Co., provide approximately four hours' storage of dilute caustic and hypo. Centrifugal pumps deliver the hypo to the operating floor for use in the bleaching process.

Process Equipment and Instrumentation

On a mezzanine above the operating floor are located two Impco stock meters equipped with DeZurik consistency regulators. One, a 28-in. meter, is for measurement of the gum stock delivered to the bleachery. The other, a 60-in. meter, also equipped with a DeZurik regulator, measures the pine stock delivered to the bleachery. Each meter is provided with an automatic level control and tonnage recorder. Both are driven by variable speed motors and are operated automatically from the main control panel in the control room on the washer floor. Unbleached stock from storage is delivered to the meters by Allis-Chalmers stock pumps through transite pipe lines. From the meters the stock flows by gravity to the base of the chlorination towers at a consistency of $3^1/_2$% (air dry).

The chlorination towers are of a new design and possess many advantages over older types. Both have steel shells and are rubber lined instead of the conventional tile lining. This provides greater capacity for the same size tank shell, and is expected to require far less maintenance. Both towers are located outside the building and equipped with their own vent system. They are easily accessible from the operating floor by means of a catwalk. Both towers are 65 ft. high and 11 ft. in diameter. The pine tower widens to $18^1/_2$ ft. in diameter 20 ft. above the ground. Rubber-lined Impco external circulators, one at the base of the gum tower, and two at the base of the pine tower, give the stock and chlorine gas, which is injected into the circulators, a rapid mixing. Towers are upflow type with launder overflow at the top. All rubber lining in the chlorination towers was installed by Raybestos-Manhattan, Inc.

The dilute stock from either or both chlorination towers is pumped to a 8 by 16-ft. rubber-covered cast iron, double valve

Impco washer. Good washing and relatively high density are obtained without press rolls. This washer, like all the succeeding washers, is provided with the latest type of 316 stainless steel hood. Wash water supply lines come up through the floor to connect to the shower manifolds. There is no overhead piping to mar the appearance of the room or interfere with the movement of the overhead traveling crane which spans the entire washer room. All washer vats are of buff tile, erected by Stebbins Engineering and Manufacturing Co., and jointed with special chemical-resistant compounds.

Stock discharged from the chlorination washer, and all the succeeding washers except the final stage, drops into an Impco double shaft mixer directly below the washer. Steam and and chemicals are added here and thoroughly mixed. The mixers, which are located on the tower roofs, discharge directly into the towers below them.

All the high density towers in the pine line; i.e., first and second caustic and first hypo, are similar in height and general design. All have steel shells 49 ft. 6 in. high with a reinforced concrete slab roof. All have 3-in. tile linings installed by Stebbins Engineering and Manufacturing Co. The two caustic towers have a net inside diameter of 10 ft. 0 in. and the first hypo tower a net internal diameter of 17 ft. 6 in. The two all-purpose towers in the gum line are 49 ft. 6 in. high also, but have a domed steel roof concrete slab above it. Lining is of special acid-resistant brick with special membranes between the lining and tank shell. Internal diameter of these two towers is 14 ft. 6 in.

All high density towers are equipped with Impco internal circulators and dilution nozzles at the base. Caustic towers have one circulator each and hypo towers two circulators each. Dilution of the stock from high consistency to pumping consistency in the bottom of the towers is automatically controlled by the power demand of these circulators.

In each case the stock is pumped from the base of the towers to the washer for that stage by Allis-Chalmers stock pumps. White water dilution pumps are also Allis-Chalmers.

All washers in the pine line are 8 by 16 ft. high submergence type, manufactured by Improved Machinery, Inc. All are cast iron, double valve type except the final washer which is all stainless steel, single valve type. The chlorination stage washer is rubber covered. The two caustic washers above the hypo towers in the gum line are 8 by 10-ft. cast iron single valve type. Vacuum is created in all washers by white water drop legs to seal boxes. Stock discharged from the final washer passes through a pan-type DeZurik consistency regulator from whence it flows by gravity to the new bleached stock storage chest.

Main operating floor of Camp's new bleach plant

NEED CLEAR SPARKLING WATER IN YOUR MILL?

N-Sol Activated Silica (made with N® Silicate and a reacting chemical) can help to improve the quality of filter water. Used with alum, ferric salts or other coagulant, N-Sol activated sol forms highly active floc that enmeshes suspended matter and settles rapidly.

Some results . . .

Reduced raw water color by more than 90%

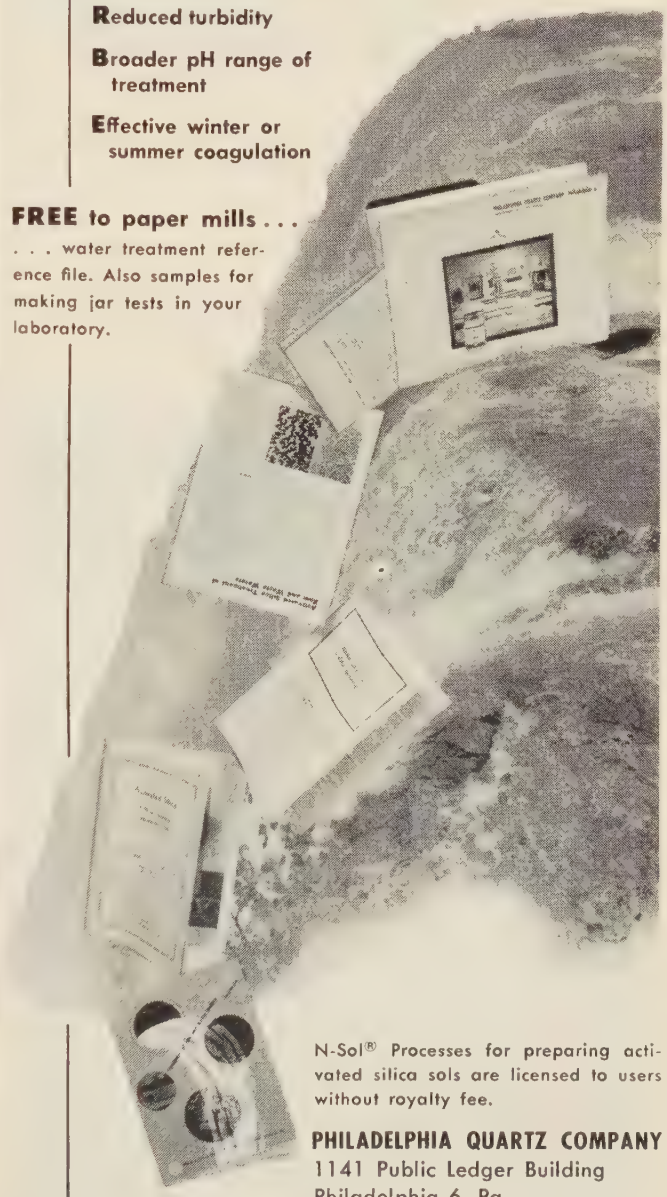
Reduced turbidity

Broader pH range of treatment

Effective winter or summer coagulation

FREE to paper mills . . .

. . . water treatment reference file. Also samples for making jar tests in your laboratory.



N-Sol® Processes for preparing activated silica sols are licensed to users without royalty fee.

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METSO® DETERGENTS

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and
AUXILIARIES
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★ COATING MACHINE

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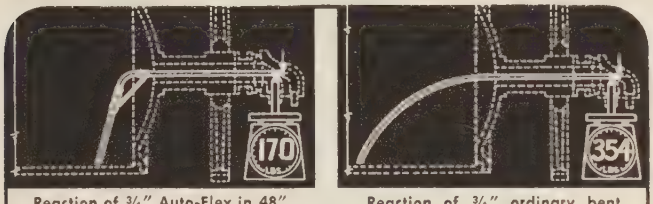
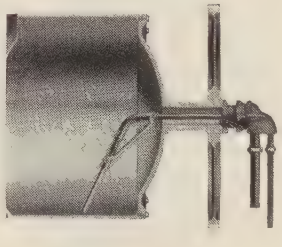


Reaction of ¾" Auto-Flex in 48" dia. dryer. Very low leverage.

Reaction of ¾" ordinary bent pipe. Syphon in 48" dia. dryer. High leverage.

THIS SYPHON HOLDS ITS POSITION AND SERVES INDEFINITELY

Midwest Auto-Flex syphons have been on the market for years and many thousands are in service for two very excellent reasons — they hold their position — they wear indefinitely.



1. The spring and brace holds the end of the pipe at the proper distance from the bottom of the dryer. It cannot take any other position—hence, proper water and air removal.

2. The cantilever leverage exerted is lower than with bent pipe syphons, only 170# vs 354#. It clears instead of dragging on the journal and rapidly wearing out.

Order a get acquainted dozen. Performance guaranteed.

MIDWEST·FULTON MACHINE COMPANY
DAYTON, OHIO

Each stage in the bleaching process is controlled from a console panel in front of the washer for that stage. All motor push buttons, valve controls, pressure gages, flow indicators, and speed controls necessary to start up, operate, or shut down one complete stage are located on that console. In conjunction with each console, any necessary records of flows, temperatures, levels, or consistency are made on chart recorders mounted on the main instrument panel in the glass-enclosed room. As a further aid to the operator, a graphic panel, representing in symbol each and every major piece of equipment and pipe line, has been provided as a section of the main panel. All the equipment comprising each stage is grouped by color scheme to represent the portion of the process controlled from each washer console. All the levels, pressures, flows, or other operating data are indicated. A red light on each pump, washer, circulator, or other piece of moving equipment indicates whether or not that item is in operation. No control or recording equipment is included on the graphic panel, it being solely an indicator of what equipment is in operation and how it is performing.

In addition to the main control panel, an auxiliary panel known as an accounting panel has been provided. On this are mounted recording and totalizing instruments for total steam, cold water, hot water, and stock furnished to the bleach plant. Starting push buttons for remote operation of bleach liquor supply pumps and miscellaneous items complete this panel. No expense has been spared to obtain precise control and eliminate wasted man power in designing the instrumentation for this plant. Practically all the instruments and panels were furnished by the Minneapolis-Honeywell Regulator Co.

The testing laboratory adjacent to the panel room has been equipped with the latest scientific apparatus for precision control of the quality of the product.

The new bleached stock storage chest is constructed with glazed structural tile walls and concrete floor and roof slab. The chest is rectangular in shape, measuring 75 ft. 4 in. by 44 ft. 6 in. outside. The interior height is approximately 16 ft. from floor to ceiling. Circulation of the stock is accomplished by four propeller type agitators furnished by Dilts Machine Works.

Supervision of construction was under the direction of W. C. Coker, plant engineer for Camp Manufacturing Co., assisted by A. J. Coleman as resident engineer representing J. E. Sirrine Co.; with Tidewater Construction Co. of Norfolk, Va., as general contractors.

Container Labs

Charles J. Zusi, president of Container Laboratories, announces that, at a recent meeting of the shareholders of the corporation, three new directors were elected to the board: Douglas Peacher, Richard Snideman, and Malcolm K. Whyte.

St. Lawrence

The Wright Co., Inc., sellers of newsprint for St. Lawrence Corp., Ltd., in Canada, are advising their customers that the new machine at Red Rock, Ont., Canada, is expected to be in production late in March, 1954, and shipments to customers should start by April 1.

St. Lawrence will be the fourth largest pulp and paper producer in Canada after completion of their $22,000,000 improvement program, which includes new paper machines in their mills at Red Rock and East Angus, Ont.

St. Lawrence will have 13 machines and auxiliary equipment producing approximately 386,000 tons of newsprint annually; 234,000 tons of kraft and capacity for 53,000 tons of surplus market groundwood and sulphite, totaling 673,000 tons of pulp and paper.

The mill at Red Rock will have a daily capacity of 200 tons of newsprint (approximately 60,000 tons annually) and 600 tons daily of kraft paper and container board.

T. Croix

Building alterations are now under way at St. Croix Paper Co., Woodland, Me. The construction has been ordered to make room for the installation of a second supercalender. The new unit will have a trim of 72 in. Company officials report that they expect the supercalender to be in operation in the Spring or early Summer of 1954.

KVP

If roadbuilders have a paradise, it certainly isn't north of Espanola, Ont., where KVP construction crews face all of the usual problems, plus a few special ones of their own.

One of their difficulties arises from the fact that the region undeveloped, so instead of staking out a route down a andy country lane, the woods engineering department has locate its proposed site by means of aerial photographs.

During the Summer, chief surveyor Morris Fisher and a mpanion blaze trees along the proposed trail. The follow- g Winter a road locating party takes to the bush in order survey the center line.

By Spring, the construction crews are ready to move out. ssistant woods manager Donald Gray sometimes has as any as 75 men working at once, but both the foreman and e size of the work force vary as the job progresses.

Early in May, the bulldozers begin their task of clearing the ay. As soon as they have made the necessary 20-ft. swath rough the forest, the trucks, graders, and cranes move in. heir job is to cut down the high spots, fill in the low ones, and ade off the rough places, leaving only the gravelling opera- on to make the job complete.

It isn't as easy as it sounds, however, if the road happens be from Ramsey to Sultan. For in addition to a number of eeks which must be crossed, there is a fairly sizable river.

But bridging a river has been a simpler operation since orld War II when an Englishman named Bailey came up th his "life size" erector set that can be assembled in a very ort time. KVP used a Bailey bridge for the first time this ar, and managed to throw a 100-ft. span across the Woman ver in just 11 hours.

The 15-mile road from Sultan to Ramsey is almost com- te now, though it represents no more than a small part of a g range building program that calls for 15 to 20 miles nually.

Road building is seasonal, but five full-time men are needed maintenance alone. At present, KVP has 134 miles of all- ather roadway, which is maintained at a cost of about $300 r mile.

Of course, actual construction is much more expensive. ess roads cost $5000 per mile, and haul roads run as high $7500 though they both pay off in faster and cheaper truck- operations.

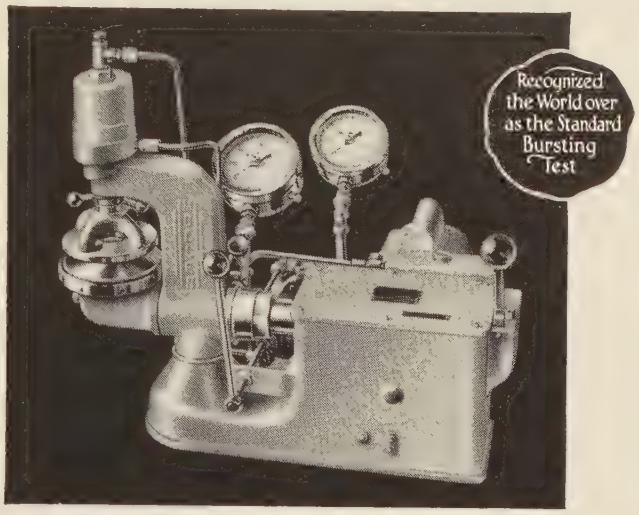
KVP is fortunate in that the Canadian Department of ighways cooperates on some of the maintenance problems. unorganized townships there are public roads which are d as links connecting the company's private roads, so smuch as KVP as well as the public use them, maintenance ts are shared by the Department of Highways and the mpany.

YONIER

The outlook for continuing high sales of chemical cellulose domestic customers at this time appears good. Overseas kets look equally bright from Rayonier's position. Ex- ts of all types of chemical cellulose registered an increase 00% for the second half of 1953 as compared with the e 1952 period. This represented 16% of total shipments this period, approaching Rayonier's anticipation of 20% roduction for overseas chemical cellulose users.

Rayonier's optimism for continued expanding export mar- ts for chemical cellulose is based upon several visible fac-

Motor Driven Model A Tester With Hydraulic Clamping Device



Especially designed for testing corrugated container board. Larger clamping area and reproducible clamping at any desired pressure eliminates crushing and slippage of the sample.

Write today for prices on these new testers, also the cost of converting your present Model A machines.

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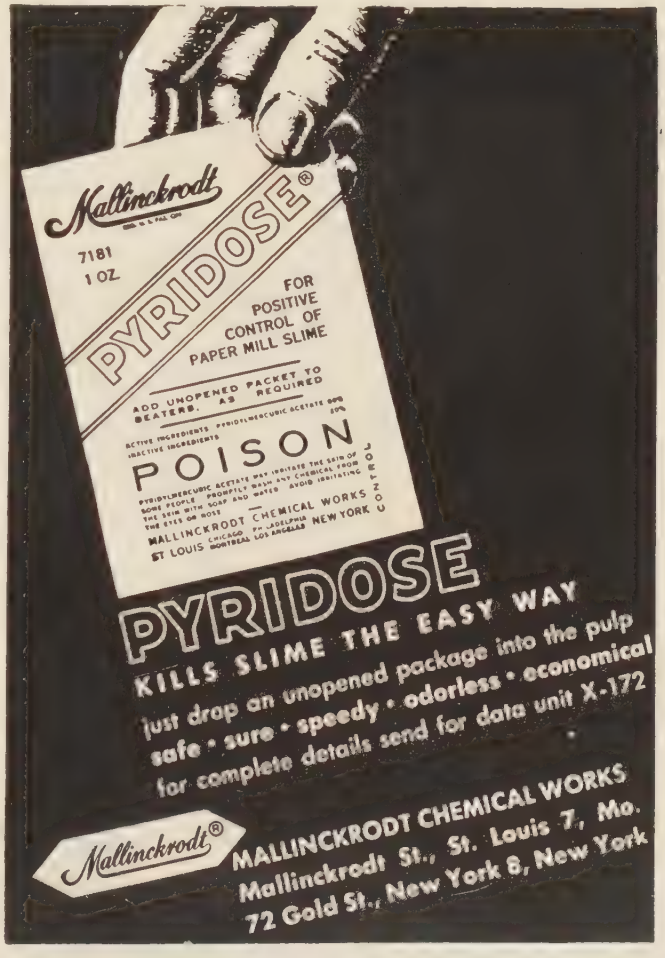
Holyoke, Massachusetts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tors: foremost is the accelerated rehabilitation and revitalization of cellulose-using industries in Europe and Japan, now being felt in cellulose producing countries. The United States has increased chemical cellulose production over 273% since 1935, the year marking the introduction of the first specific type of chemical cellulose produced for a specific product other than rayon. For 1953 the United States will have produced more than 715,000 tons. This represents nearly 50% of the free world's 1953 production.

Increased world demand for chemical cellulose can best be satisfied by North American producers, as the economic source for cellulose is trees. For only on the North American Continent are trees economically replenishable.

The rising acceptance of the cellulosics parallels recent advances made in cellulose chemistry. These are the new, improved chemical cellulose for such products as tire cord, rayon, cellophane, film, and the cellulose gums. Superior tire cords and washable rayons with new high tensile strengths are soon to become available through the development of new cellulose types such as Rayocord-X which make it possible to utilize the textile industry's new high-stretch spinning techniques. This forecasts new markets for chemical cellulose,as the cellulosic fibers with their low costs may now invade the sheeting, handkerchief, shirting, and other soft goods markets heretofore dominated by natural fibers.

There are indications Rayonier's policies of published and stabilized pricing, regardless of market fluctuations anywhere, are being adopted by cellulose producers outside the United States. It has been Rayonier's contention that cellulose-using industries profit from such supplier policies. Price stability is an important sign of increasing world-wide acceptance and demand for the cellulosics and a strengthening of their markets.

Sales of chemical cellulose to United States cellophane, tire cord, plastics, and film industries remained at a high level during 1953 and the sales outlook for 1954 to domestic and overseas customers is attractive. Rayonier does not foresee any price reductions in chemical cellulose at this time. Neither labor costs nor costs of services and supplies essential to chemical cellulose production have been reduced, and there are no indications that these costs will decrease in 1954.

Nor can we say that the United States consumption of chemical cellulose will accelerate rapidly in 1954. A "snowballing" or "explosive" increase in its consumption for any specific product has been the industry's history. Chemical cellulose growth has been remarkably greater over the past 25 years than most basic raw materials, including steel. But for the future, the over-all growth of chemical cellulose will probably be more steady and sure.

There will be major new uses for chemical cellulose in the future requiring production facilities far in excess of today's free-world capacities of some 3,100,000 tons. Industry projections show this capacity to be 3,500,000 tons by 1955. But the fact that all converters are not always at full capacity at one time is an equalizing factor placing the chemical cellulose industry into essential balance.

Broader markets for chemical cellulose are seen as living standards in the free world improve. While the United States consumes annually over 7 lb. of the cellulosic fibers per capita, the 2 billion free people outside use less than 1 lb. each. An increase of only 1 lb. per capita consumption in the free world outside the United States would require a $33^1/_3\%$ increase in world chemical cellulose capacity.

Rayonier fully expects this increased demand and is preparing for it. By March, 1954, the company's fifth and newest mill at Jesup, Ga., will be in operation. It will have an annual capacity of 87,000 tons. Being constructed as "a mirror image" plant, this capacity can be doubled with comparative ease.

Rayonier's confidence in a steadily rising world-wide demand for cellulosics is supported by recent surveys which forecast world consumption of rayon and acetate fibers alone attaining an annual production of over 7 billion pounds by 1960. This is an increase of approximately 100% over current production and consumption figures.

—Year-end statement of Clyde B. Morgan, president, Rayonier Inc., New York, N. Y.

Powell River

It is just over 41 years since Powell River Co. turned out the first sheet of commercial newsprint ever manufactured in Canada west of Ontario. The story of Powell River's development during these years is the story of Canadian pulp and paper, now Canada's first manufacturing industry.

When the first rolls of paper were whisked off the paper machines in April, 1912, total production of newsprint in Canada was less than 400,000 tons. The United States was the world's foremost producer, with Great Britain and Scandinavia next in line.

Today, Canada is the giant among newsprint producers. Out of the approximately 10 million tons of paper manufactured annually by all nations, Canada produces more than one half. Canadian newsprint and pulp are sold in the four corners of the world; from the borders of the Arctic Circle to the lands below the tropics; in the far east and throughout the western hemisphere.

This emergence of Canada as the world's foremost producer of newsprint is an outstanding development of our 20th century industrial life. Throughout the 19th century the huge reserves of power and timber, which form the basis of our pulp and paper supremacy, were largely undeveloped. As late as 1880 there was not a single pulp and paper mill listed on the census of Canada. At the turn of the century, the total value of the Canadian pulp and paper industry totaled a few thousand dollars.

The ten years following World War I witnessed the great forward leap of the industry to first place among world producers. In 1926, with a production of approximately 1,500,000 tons, Canada's output exceeded, for the first time, that of United States mills. Today, United States newsprint production has declined to about 1 million tons annually while Canada has increased hers fourfold.

The twenties also saw a tremendous expansion of new mills throughout the country—and even before the depession in 1929, capacity of Canadian mills was far in excess of demand. With the depression of the thirties, bankruptcies and receiverships were common. In this period, Powell River, well managed and with a sound financial background, weathered the storm, and took advantage of slackness in orders to improve existing installations and methods. The company swung out of the depression in a sound competitive position—one of the soundest in the industry.

In 1930 Powell River installed its seventh newsprint machine, one of the three new machines to go into production in Canada between 1930 and 1948.

Following the depression, the advent of World War II, and the expanded postwar demand for pulp and paper products, the industry became re-established on a strong and stable foundation. Demand had caught up with and surpassed capacity, and manufacturers were able to increase their assets and reserves. Today, the pulp and paper industry, after a retarded childhood and a shaky youth, has grown to powerful, vigorous manhood. Its foundations are solidly entrenched.

Powell River, built on a sturdy foundation, has weathered all the shocks and impulses of her 41 years of uninterrupted production. Research, operating, and technical staffs have combined to maintain the quality of their product and the maximum output of their machines. Powell River was the first company to install a new newsprint machine after World War II, and since that date has embarked on a program of modernization that has further increased output and improved efficiency and quality.

In its 41 years the company expanded production from 100 tons to 1100 tons of newsprint daily, and since 1937 has installed equipment for the production of 135 tons of unbleached sulphite pulp daily.

In 1953, as the Canadian pulp and paper industry breaks new ground in production, Powell River, as the world's largest individual producer of newsprint, is proud of its contribution to and its share in the development of this great Canadian industry.

Brown

Another Brown Co. product scores a hit among leading United States manufacturers. This time it's Solka-Floc, a highly refined wood cellulose, similar in appearance to flour and often called Brown Co.'s "miracle" product.

The Liggett & Myers Tobacco Co. is now buying Solka-Floc from Brown Co. for use as a filter aid in the manufacture of L & M cigarettes, believed to be the newest filter type cigarette on the market.

The Liggett & Myers Tobacco Co. disperses the Solka-Floc in acetate fibers. These acetate fibers are what you see when you break open one of the filter tips. If you were to shake these fibers over a dark surface, you would notice some of the Solka-Floc dropping to the surface. Very little of it will drop to the surface, however, because of the unique method Liggett & Myers has of dispersing it in the fibers.

The acetate fibers, while they do a small amount of the filtering, are not the main reason for the cigarette's efficient filtration. The Solka-Floc actually forms the long, deep filter for the smoke.

Solka-Floc was developed in 1930 by Brown Co. and proved to be another "first" in the company's constant effort toward developing new products from wood.

H. P. Andrews

Effective Jan. 1, 1954, H. P. Andrews Paper Co., 14 W. 3rd St., New York, N. Y., set up a chemical division that carries a full line of sensitizing and processing chemicals for blueprint and diazotype. Ringwood Chemical Corp., Ringwood, N. J., has appointed Andrews distributor of the Edwal line of sensitizing chemicals to the reproduction paper industry.

The following information on the coating of reproduction papers is taken from a booklet titled "Reproduction Paper Coating," by Edward Jahoda, published recently by Andrews.

Coating Chemicals

The chemicals for light-sensitive coating solutions are subject to very specific requirements as to purity and strength. Unless they are uniform from batch to batch, the coating operation will be hampered and consistent printing results cannot be obtained. Chemicals meeting these high standards can be manufactured only by experienced chemical companies with specialized equipment for production and laboratory control.

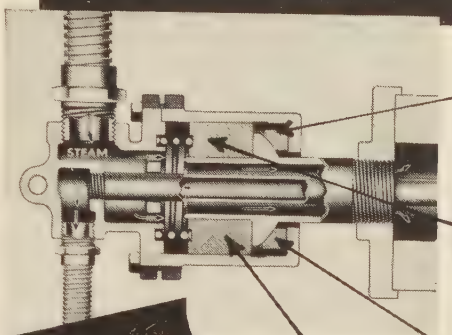
In the early days of the diazotype processes the diazo compounds had to be manufactured by the paper coater. For several years now, a great variety of stabilized diazo compounds is available commercially at reasonable prices; due to improved methods of manufacture and stabilization, they can be safely shipped and stored for future use. For the coater to make his own diazos is as outdated a practice as for the architect to coat his own reproduction paper.

The chemicals that can be supplied by us are listed in the following; they are packaged and shipped in moistureproof containers or in heavy polyethylene film bags within fiber drums. Sources of supply for other coating chemicals will be furnished on request.

Reprint Chemicals:

Developer—a stabilized, solid peroxide compound, excellent for bluelines, not toxic, not staining. Cost as low as that of potash.

New answer for calenders



PACKLESS—Seal ring now redesigned for as much as 25% longer life.

SELF-LUBRICATING—Special carbon graphite needs no lubrication.

SELF-ADJUSTING—Pressure itself is sealing force.

SELF-SUPPORTING—And now smaller and lighter for easier handling and installation.

TYPE S SERIES 2000 Johnson Joints

In today's new Type S Johnson Joint you have an old favorite, streamlined to decrease size and price while increasing operating life. It is still completely packless, self-lubricating, self-adjusting and self-supporting. For handling steam and condensate on calender rolls there never was a better answer than the Type S; with the Series 2000 you can save the cost of switching over quicker than ever.

Get full information; write for catalog.

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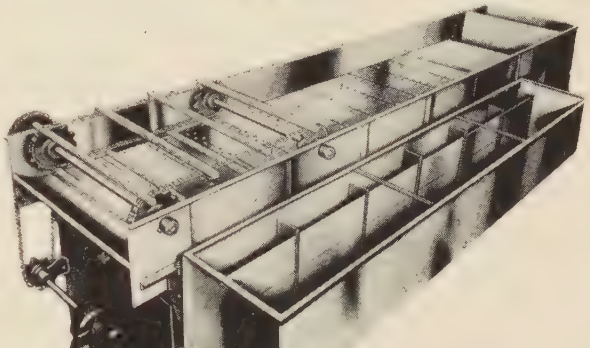
MURCO STAINLESS STEEL FLAT SCREEN



ALL PARTS IN CONTACT WITH PAPER ARE STAINLESS STEEL

VAT BOX MAY BE TILTED For Rapid change of screen plates and washing out

Particularly adaptable for running different colors and grades of paper and board stock—any operation where cleaning and preparing the screen for the next run demands continuous production without loss of time . . . color changes may be made without tipping up plates . . . built for 8, 10, 12 or 14 plates. Ask for complete details.

MURCO

D. J. MURRAY MANUFACTURING CO.
MANUFACTURERS SINCE 1883
WAUSAU WISCONSIN

Mertone—a quality building precoat for blueprint paper.
Persulphate (pot.)—for latitude formulas, to increase line pickup; used in small amounts.
Prussaid—forms a very light-sensitive compound for blueprint paper by combining with ferricyanide in solution. Very suitable for extreme latitude papers with no bleed or burn-out. Used to increase printing speed of conventional formulas.
Washaid—valuable for all types of blueprint solutions, especially for dark blue coatings; has a combination of useful properties; acts as wetter, thickener, wash-out agent, and stabilizer. Also used as additive to Mertone precoat solution.

Diazo Compounds (Light-Sensitive):

Diazo No. 1—for ammonia process; gives a strong yellow coating that permits easy inspection of exposure before developing; can be used in combination with other diazos.
Diazo No. 8—for ammonia intermediates (brownlines), with resorcinol as coupler.
Diazo No. 9—generally used diazo for ammonia bluelines and blacklines. Forms a blue, waterfast dye with coupler No. 111.
Diazo No. 10—for ammonia blacklines of slow and medium printing speeds.
Diazo No. 12—for moist process, neutral development. In small amounts with Diazo No. 14 for alkaline development.
Diazo No. 14—for moist process, alkaline development. Replaces Diazo No. 57.
Diazo No. 38—for ammonia bluelines and blacklines, all printing speeds; good stability. Forms a blue, waterfast dye with coupler No. 111. Replaces Diazo No. 47.
Diazo No. 49—for ammonia bluelines and blacklines, all printing speeds; exceptionally strong and stable compound; does not require stabilizers in the solution. Forms a blue, waterfast dye with coupler No. 111.
Diazo No. 67—for ammonia redlines, with phloroglucinol as coupler.
Diazo No. 77—for moist process intermediates, alkaline development.
Diazo Litho—sensitizer for lithographic printing plates.

Diazotype Couplers and Developers:

A-developer—a solid source of ammonia, for the development of ammonia prints.
No. 111—blue coupler for ammonia paper; forms brilliant, waterfast dyes with diazos Nos. 9, 38, 49.
Chap—red coupler for ammonia paper; recommended with diazos Nos. 1, 8, 9, 38, 49. Also for moist developer.
Dinol—blue-green coupler for ammonia paper; recommended with diazos Nos. 9, 38, 49.
M-developer—for moist process, alkaline development. Packaged in moistureproof film bags within black envelopes. Available in units for 1, 2, and 4 quarts of solution, or in bulk. For the colors: black, blue, brown, yellow, red. Individual developer formulations packaged on confidential basis, in minimum lots of 1000 units.
Phloroglucinol—black coupler for moist paper.
Resorcinol—brown, opaque coupler for ammonia and moist paper. Free flowing grade.
YAA—yellow coupler for ammonia and moist paper. Color shader in ammonia blackline paper.

Auxiliary Chemicals:

Aluminum sulphate—iron free. Finest papermaker's grade. Suitable for sensitizing solutions.
Flosspowder—additive to precoats and sensitizing solutions.
Foampowder—for smoother flow and better spreading of all types of coating solutions; helps to eliminate dry spots and facilitates coating of hard-sized papers.
Precoat M—for ammonia paper. Highly concentrated.
Precoat P—for ammonia paper. Highly concentrated.
Stabilizer—for diazotype solutions. Naphthalene trisulphonic acid, sodium salt.
Thiourea—antioxidant. Special diazotype grade, iron free.
Wetter No. 100—powerful, nonionic wetting agent. For coating transparentized stock; prevents "silvering" of brownline solutions on regular stocks.

For coating places where compounding of the sensitizing solutions is not practical we can supply dry mixtures of the chemicals for the complete formulation of blueprint or diazotype solutions.

Precoating

To yield prints with strong lines and brilliant colors the coated paper must have a sufficient amount of color forming chemicals situated on the surface. Reproduction base papers must be sized to restrict penetration. Yet the sizing also restricts the lateral flow and makes the paper less receptive for the sensitizing solution; it limits the amount of chemicals that can be deposited. A superior coating surface can be created by precoating the base paper with an inert, colloidal solution; this superimposes onto the surface of the sized paper a multitude of extremely small, discrete particles which increase the effective surface area. Moreover precoating promotes the lateral flow and compensates for the adverse effect of the sizing in this respect; in consequence the succeeding coating of the precoated paper with sensitizing solution is greatly facilitated. While all papers show some improvement by precoating, not all of them show it to the same degree. Certain base stocks require slight modifications of the regular precoat solutions to give the best possible result. Precoated prints excel by their unmatched brilliancy. Entirely new standards of quality for prints have been established by our precoat processes.

Blueprint Precoat. The precoat material for blueprint paper is a water solution of colloidal silica. It is obtained by diluting "Mertone WB-2," a product of the Monsanto Chemical Co. The Monsanto Chemical Co. holds the licenses on our precoat patents in the United States (No. 2,433,515), in Canada (No. 448,981), and in Great Britain (No. 647,197). All coaters who wish to practice the precoat process for blueprint paper in these countries must acquire a sublicense from Monsanto. Certain ingredients of the sensitizing solution can be incorporated in the precoat solution; this opens the way to new variations of coating formulas and procedures. Feathering of writing inks and correction fluids on Mertoned prints can be minimized by addition of antifeathering agents to the precoat solution. Formulas for nonfeathering inks can be supplied.

Mertoned blueprints have an excellent pencil surface; markings and corrections can be made by pencil much faster and more satisfactorily than by ink. Good results are being obtained with the blueprint marking pencils Verithin (Eagle Pencil Co., New York, N. Y.) and Colorbrite (Eberhard Faber Pencil Co., Brooklyn, N. Y.). Suitable colors: white, silver, yellow, green, red, orange. Color charts are available on request.

Directline Precoat. The precoat processes for direct process paper are based on similar physical principles as the one for blueprint paper. Colloidal silica can also be used for direct process paper, but it has some disadvantages. Much better materials for precoating direct process papers are copolymers of synthetic resins in colloidal water solutions. For the different processes and for different coating conditions we have prepared a variety of precoat materials. Applications for patents on the precoat process for direct process papers are pending in the United States and abroad.

All precoated direct process papers have increased resistance to the influence of the atmospheric moisture and therefore better shelf life. On direct process prints precoated with synthetic resins writing inks and correction fluids do not feather.

Licenses for the use of the precoat process for direct paper will be granted by us. Inquiries are solicited.

Precoated diazotypes are distinguished by greatly increased contrast. Even weak pencil lines stand out sharply on the print background. The legibility of such prints is greatly enhanced.

Wrapping of Sensitized Papers

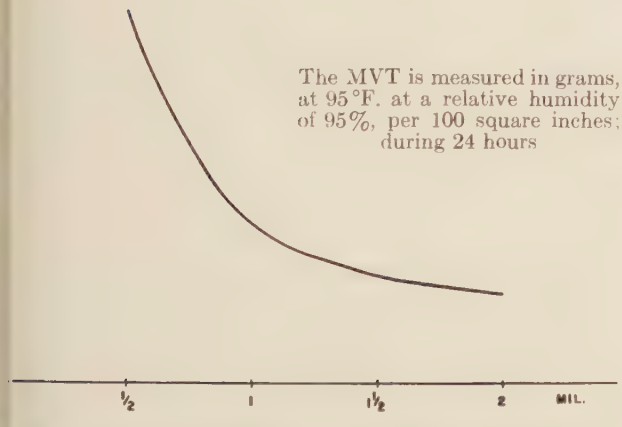
The wrapping of reproduction papers serves the dual purpose of protection against the light and against a change of moisture content, therefore the wrapping materials must be both opaque and impermeable to moisture. Conventional methods of wrapping require multiple layers which are awkward to handle and which do not always provide safe protection. The modern method uses a single sheet wrapper containing a film of polyethylene, one of the most moisture resist-

	Blueprint		Precoat
	397,480	2,165,166	
	625,527	2,166,546	2,433,515 (Re.
	895,970	2,172,319	23,510)
	917,418	2,188,900	
	1,500,433	2,189,264[b]	
	1,518,997	2,196,788	
	1,599,147	2,199,368	
	1,712,428	2,209,548	
	1,772,342	2,209,917	
	1,776,155	2,218,969	
	1,861,298[a]	2,221,628	
	1,877,246[a]	2,229,727[a]	
	1,998,883	2,237,084	
	2,014,692[b]	2,238,301	
A	2,025,675	A 2,264,334	
	2,093,421[a]	2,291,130	
	2,093,738	2,317,521	
	2,113,423	2,323,798	
	2,126,504	2,323,799	
	2,130,070	2,346,872[b]	
	2,130,071	2,350,991	
	2,135,872	2,398,986	
	2,137,015	2,443,844	
	2,154,506	2,495,661	
	2,1 8,422[b]	2,517,111	

g resins. The polyethylene film can be either coated on e side of an opaque kraft paper or laminated between two ets of the same. Such wrappers assure much better pro- tion than most multiple wrappers at substantial savings of or in the wrapping operation; they are suitable for ship- nts to all climates, including the Arctics and the Tropics. e use of polyethylene wrappers for reproduction papers is ng developed by the H. P. Andrews Paper Co. in close co- eration with the International Paper Co.

Polyethylene film resists the action of water, ammonia, most vents, and of many corrosive chemicals. It is an excellent isture vapor barrier over a wide range of temperatures. folding strength is extremely high. The films are neutral, rless, tasteless, not toxic, slow burning, and do not de- iorate with age.

T
M.



isture vapor transmittance of polyethylene in relation to film thickness

olyethylene wrappers show equally low moisture vapor nsmittance (MVT) whether flat or severely creased. The T of such a wrapper depends on the film thickness of the ethylene; see graph.

	Diazotype		
	1,444,469	2,178,771[e]	2,500,099
	1,594,470	2,183,447[e]	2,501,874
	1,628,279	A 2,196,950	2,516,931
	1,751,318	A 2,197,456[d]	2,523,882
	1,752,174	2,198,827[c]	2,523,889
	1,753,059[c]	A 2,199,925[c]	2,525,751
	1,753,708	A 2,205,991[e]	2,528,395
	1,756,400	2,209,087[e]	2,528,460
	1,758,676	A 2,212,959	2,529,464
	1,760,780[d]	2,215,739[c]	2,531,004
	1,770,352[c]	A 2,216,137[e]	2,531,091
	1,803,907	A 2,217,189[e]	2,531,485
	1,807,761	2,228,562[e]	2,532,126
	1,811,029[d]	A 2,233,038	2,532,744
	1,816,989[c]	2,239,704[e]	2,533,185
	1,821,281[c]	A 2,241,104[c]	2,536,398
	1,821,306[c]	2,245,628[f]	2,536,989
	1,837,679[c]	A 2,246,425[f]	2,537,001
	1,841,653[c]	2,277,409[e]	2,537,098
	1,841,801[c]	A 2,281,895	2,537,106
	1,845,989[d]	A 2,286,656	2,537,919
	1,853,462	A 2,286,701[c]	2,541,727
	1,857,920[c]	A 2,295,632[f]	2,541,886
	1,861,330[c]	2,298,444	2,542,560
	1,870,930[c]	2,308,058[c]	2,542,566
	1,906,240	2,311,016[e]	2,542,715
	1,926,322[d]	Ae 2,313,288[e]	2,542,716
	1,934,011[d]	2,318,352[e]	2,542,848
	1,936,957	A 2,322,982	2,542,849
A	1,964,358	2,326,728[c]	2,542,850
A	1,966,755[c]	2,336,309	2,545,057
A	1,967,371[d]	2,350,843	2,545,423
A	1,971,966	2,354,088	2,546,791
	1,973,788[e]	2,374,563	2,547,843
A	1,983,005	2,375,366	2,548,845
A	1,989,065	A 2,378,583	2,551,133
A	1,993,812	2,381,984	2,551,570
A	1,994,735[e]	2,405,523[e]	2,552,354
	2,014,744[c]	2,411,811	2,552,355
A	2,022,014[f]	2,416,021[e]	2,560,137
A	2,026,292	2,416,773	2,566,709
	2,027,229	2,418,623[e]	2,571,670
	2,034,508[c]	2,429,249[e]	2,571,671
A	2,037,542[c]	2,431,190	2,591,309
A	2,051,582[f]	2,432,549	2,593,839
A	2,051,583[f]	2,432,593	2,593,911
	2,051,584[f]	2,437,868	2,593,928
A	2,051,585[f]	2,442,061	2,595,916
	2,051,586[f]	2,456,514[c]	2,597,306[e]
A	2,063,832[c]	2,465,424	2,597,412
	2,067,690[e]	2,465,760	2,598,453
	2,083,285[e]	2,467,358	2,600,996[c]
	2,095,408[de]	2,474,700	2,602,740[f]
	2,106,868[e]	2,485,122	2,602,741[f]
	2,110,973[c]	2,487,034	2,602,742[f]
	2,113,193[c]	2,489,728	2,603,564
	2,113,944[c]	2,490,605	2,605,182
A	2,114,468	2,495,827	2,606,117
	2,141,103[c]	2,496,196	2,613,149
A	2,150,565[c]	2,496,240	2,616,803
A	2,151,532[c]	2,500,096	2,617,726
	2,157,206		2,617,727
A	2,158,836[c]		2,618,555[d]

[a] Predeveloper.
[b] Semiwet development.
[c] Moist process.
[d] Negative process.
[e] Development by heat, steam, or other nonconventional means.
[f] Reflex process.

For single wrapper protection we recommend: a 60-lb. kraft with a 1-mil polyethylene film, or 30-lb. kraft/1 mil polyethylene film/30 lb. kraft laminated.

Such wrappers have in the creased and folded spots five times the moisture vapor resistance than most waxed papers.

We have in preparation a considerably improved polyethylene wrapper which will have a still lower moisture vapor transmittance.

Expiration dates of U. S. Patents

r to January 1 of the year.....	1953	1954	1955	1956	1957	1958
patents expire up to No. (inclusive).....	2,026,515	2,066,308	2,104,003	2,142,079	2,185,169	2,227,417

International's polyethylene wrappers are available in different opaque colors, including jet black, with polyethylene films free of pinholes, from $^1/_2$ to 2 mils either coated on one side or laminated between two sheets of paper. The laminated wrapper appears and handles the same as regular kraft paper but has built in the moisture resistance of the polyethylene; the two sides of such a wrapper may be papers of different colors. Polyethylene wrappers can be obtained in colors matching existing wrapping materials; they can be overprinted with company names, trade marks, or any desired kind of design. They also can be obtained creped, in one or two directions, for cases where extraordinary impact strength is required.

Polyethylene films can be heat sealed at a temperature of approximately 275°F. Very strong bonds can be obtained film to film, or film to paper.

Heat-sealing equipment for polyethylene is available in a great variety of hand models, foot-operated table models, and automatic machines. Illustrated folder will be sent on request.

Polyethylene is one of the lightest films. The basic weight of a polyethylene wrapper is the basic weight of the kraft paper plus 14.5 lb. for a 1-mil film. To convert prices established on square yardage basis to a net pound basis, multiply the price per 100 sq. ft. by 3, then divide the product by the total basic weight of the wrapper.

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Union Bag

A $25,000 grant by Union Bag & Paper Corp., is going to make possible a forestry education and demonstration building at the 4-H Club's new state center at Rock Eagle Park.

The Rock Eagle center, now in the building stage, is designed to give every 4-H boy and girl a chance to attend a 4-H training camp during the year—a big improvement over present camping conditions which have been hampered by limited facilities.

The $25,000 gift to the 4-H Club will be used to construct one of eight educational and demonstration buildings at the camp site. The building will house forestry equipment that will be studied by 4-H'ers as a means of keeping up to date on the latest methods of conservation and woodland management. The structure will be named the Union Bag & Paper Corp., Forestry Building.

Since the state is matching the $25,000 gift of Union Bag, the 4-H center is actually realizing a total of $50,000.

Union Bag has just completed conversion to Savannah's newest fuel—natural gas. The company was the first local industrial plant to sign a natural gas contract. The three largest power boilers and all four of the lime kilns are using natural gas at the rate of approximately 34 million cubic feet a day. The plant's largest power boiler, Number Ten, which accounts for approximately one third of Union Bag's electrical production, consumes the natural gas at a rate running around 600,000 cu. ft. an hour.

The new fuel is burned in the three largest power boilers to produce the 56,000 to 60,000 kw-hr. of electricity the plant consumes every hour. The four lime kilns are part of the plant's recovery process and reclaim lime from the spent cooking liquor.

The natural gas for the plant is piped in from the gas fields under pressures varying from 700 to 1200 p.s.i. to a point about 9 miles outside of Savannah.

There the pressure is stepped down to 325 lb. and the gas is brought into the metering station located in the city's industrial area just west of Savannah. Here the pressure is stepped down again to about 50 lb., and the gas is metered and piped into the plant.

The pressure is further reduced to about 20 p.s.i. at the point of burning.

Crystal

To state that the Crystal Tissue Co. of Middletown is directly related to the first brick ever laid in the city of Cincinnati would be stretching a point, but our historical searching has shown some very distinct historical connection between the two. During the course of one of its many constructions this company purchased in 1910, a very historical site in the form of the old Dickey homestead immediately adjoining the plant at that time. Adam Dickey had settled there in 1801, and it was he who reportedly made there, the first brick ever laid in a house in Cincinnati.

It was this same Adam Dickey, who by the nature of one of his many enterprises, can be considered one of the predecessors of that early mill which developed into today's modern Crystal Tissue Co. Because of the abundant power supplied by the Miami and Erie Canal, Adam Dickey, in 1827, started a sawmill adjoining his homestead. It was in 1827 that the canal was first opened to navigation and power utilization in that area, and in order to realize how early this really was one has only to remember that in 1827 the Indians had left the

area for just a scant 20 years. As the country became more settled, the establishment of farms decreased the need for lumber, while increasing the need for flour mills. The resulting Dickey flour mill was operated until 1886 when it was converted into a strawboard mill. This "infant" firm was known as the Parent Paper Co. Caleb Parent was president and Charles A. Phipps, secretary-treasurer. The mill's equipment consisted of four 1000-lb. engines (a considerable size for those days) and one 68-in. double cylinder machine manufacturing seven tons of strawboard per day. By 1890 the property was known as the Middletown Straw Board Co. in which Phipps has graduated to the presidency and a famous Ohio financeer had entered the scene as vice-president. This was Charles P. Gunkel whose name appears again and again in Ohio's papermaking history. He was directly connected with one of the earliest papermill trusts on record, the construction of railroads, and also had a hand in politics. His actions and transactions are reflected in the fortunes of many of the earlier mills in the state.

Organizational changes came thick and fast for the mill during the ensuing years but actual organizational stability was not reached until the turn of the century. In 1892 the mill was known as the Ohio Valley Paper Co. This was changed to the United Paper Co. which listed its offices as being located in the Times Building in New York City. In 1897 G. W. Van Dyke became president of the organization and the name Crystal was adopted. The mill's equipment at that time consisted of four 800-lb. and two 1500-lb. beaters, two of the then just incoming jordans, and two 68-in. cylinder machines. By that time the mill made waxed papers, because sanitary methods of packaging were rapidly being accepted as "desirable" with widespread use of waxed papers the logical development. In fact it had been Crystal which actively participated in National Biscuit's revolutionary packaging developments in the latter's move from "the barrel to the box."

Crystal Paper Co.'s subsequent growth came very quickly. In 1902 a 72-in. fourdrinier was added. In 1906 one of the old cylinders was replaced with a 100-in. machine. At that time a 100-in. machine was unheard of in the manufacture of tissue, and the mill's management actually experienced difficulties in getting a machine builder to accept the order. It was only after absolving the builders from responsibility that the machine was constructed. That it was successful is of course shown by construction of even larger machines within the next few years thereafter. The years of 1911 and 1912 saw the erection of a new mill, following the acquisition of the Dickey homestead. Into this new mill went a 120-in. machine, again the widest lightweight cylinder machine in the world at that time.

G. W. Van Dyke was followed by J. W. Van Dyke, presumably his son, under whose guidance the company consolidated its rapid growth. D. E. Harlan assumed the management of the mill for Van Dyke and much of the company's later success has been attributed to his engineering know-how. When Harlan retired in 1920 he was succeeded by Z. W. Ranck from whom he had groomed for the job for many years. As the market for waxed papers and tissue broadened ever further, additional expansion became possible in 1927. A 100-in. fourdrinier was installed, followed by still another, a 120-in. in 1930. The mill had come a long way since its early beginning as a strawboard factory.

From an operation insignificant by today's standards, through many changes and some real problems, from a business establishment operated as an early settler's sideline to the achievement of major industrial status, Crystal Tissue Co. may be considered a true contributor to the romance of Ohio's papermaking history.

—*by* Ernest F. Barker

D

1953 has seen some interesting and different uses for Bird Fibreboard, manufactured by Bird & Son, Inc., East Walpole, Mass. Last March, 30,000 baby chicks traveled safely from Massachusetts to Cairo, Egypt, in Bird Chick Boxes. There have been two other similar shipments this year, part of a program to improve the food situation along the banks of the Nile. It was a tricky assignment. Newly hatched chicks can live 72 hours without food or water. The trip to Cairo is 48 hours. They made it successfully with time to spare.

Bird makes egg cases too, holding 30 dozen, replacing the former wooden crates and carrying the fragile cargo safely.

Flowers and fish have little in common, but Bird has found a way to ship them both in paperboard containers. A coating of wax does the trick. It kept the moisture in, prevents the package from becoming soggy. Delicate orchids are successfully shipped from Connecticut to St. Louis in these new containers Fresh New England seafood, quick frozen and then packed in waxed containers, travels by air or fast freight from Eastern seaports to Midwest cities and arrives in A-1 condition, thanks to Bird Fish Trays treated with a coating of wax on both interior and exterior.

Working with a Cape Cod lettuce grower, Bird has recently developed a package for shipping fresh lettuce. This new method, first started on the West Coast, has proved itself superior to the old method where wooden crates of lettuce were packed in ice. Fresh picked lettuce is now chilled quickly by a vacuum cooling process which penetrates to the very heart of each head of lettuce. The tightly wrapped leaves stay cold for several days when the lettuce is packed in ventilated Bird Boxes and shipped dry in refrigerator cars cooled only with ice in the bunkers. Each head arrives crisp and fresh at the retail store with no spoilage of outer leaves, commanding a price of 2 to 3¢ more because of its excellent condition.

The versatile fork lift truck has revolutionized handling of materials in and out of warehouses and freight cars. Bird Fibreboard is lending a hand to one of the latest material handling innovations. It serves as the base for unitized loads of bags of material. Bags of lime, cement, fertilizer, and other similar materials are filled by a special machine which removes all excess air. This allows them to lie flat as they are placed one on top of another and held lightly together with a dab of adhesive—enough to hold them on the load but not enough to tear them when lifted off. Unitized in this way, large loads of bulky material can be picked up by fork lift and loaded into trucks or freight cars without any handling at all. The smooth surface of Bird Fibreboard helps the fork slip easily between the bottom of the load and the floor. At the final destination cars and trucks are unloaded by the same process. Freight cars that used to require hours to unload are emptied in jig time. The labor cost of loading and unloading is reduced to a fraction of what it used to be and the loads store more compactly in the warehouse.

Bird Horticultural Products, once known to only a few greenhouse men in New England, now are world travelers. Not only do we sell Vita Pots, Vita Bands, and the whole horticultural line to commercial growers in the United States, but we ship these items to such far away spots as South Africa, Hawaii, Cuba, Alaska, Australia, Newfoundland, Iceland, and Nicaragua. There is great interest in our products, too, in England and Continental Europe, but the economic situation there has prevented sales in these areas up to the present time. New products of a few years ago, like Vita Pots and Vita Bands D, H, and 10, are now well established. Perennial Pots for growing plants, first introduced last year, are selling well, too. Nurserymen pot roses, chrysanthemums, azaleas and evergreens in Bird Perennial Pots well in advance of the selling season. Later the plants are sold in these same containers, saving all of the time and inconvenience of digging and wrapping at the time a plant is purchased.

For over 45 years, Bird & Son has been selling shoe cartons to manufacturers throughout the country, with agents stra-

tegically located to provide needed service. This operation more recently has been supplemented by establishment of setup stations in Auburn, Me., and Manchester, N. H. An important feature in today's merchandising of shoes is to have uniform, quality cartons in the retail store. The Bird plan of distribution achieves this, even though the shoes on the shelves may have come from widely scattered points.

Sisalkraft

The Sisalkraft Co. announces a merger with its manufacturing division, The American Reenforced Paper Co., effective Jan. 4, 1954. The organization has been renamed American Sisalkraft Corp. The firm, which manufactures a line of waterproof papers, insulation and box tape products, will move certain key personnel to its plant headquarters in Attleboro, Mass. Regional sales offices will remain in Chicago, New York, and San Francisco. "The change," says W. N. Stevenson, president, "will mean a more integrated, efficient organization resulting in improved facilities for better service and better products for our customers." One highlight of the move will be increased activity in merchandising and research techniques.

National Container

Announcement was jointly made by Samuel Kipnis, president of National Container Corp., and Fredric R. Mann, president of Seaboard Container Corp., that Seaboard, largest nonintegrated manufacturer of corrugated kraft shipping boxes in eastern United States, will become a division of National Container Corp. Seaboard's plants at Bristol, Pa., and Newark, N. J., will continue to be operated independently under their present management. Mr. Mann, who has been chief executive of Seaboard since its inception in 1930, will join top management of National Container Corp. in an important executive capacity and will become a member of the official family of National.

The statement emphasized that "Seaboard's relations with its customers would continue as heretofore with greater facilities for their servicing and with a more varied and diversified line of products available to them. All employees of Seaboard will continue to be employed at the same plants as at present."

National Container Corp., one of the largest fully integrated producers of corrugated kraft board and boxes in the industry, presently operates 19 box plants and five kraft pulp, board, and paper mills, with a new mill having a 500-ton per day capacity nearing completion at Valdosta, Ga.

Part of the newly-established 15-acre Natcon Nursery at Lake Butler, Fla., developed and dedicated by National Container Corp., where 5 million pine tree seedlings are planted, is inspected by Florida State forester C. H. Coulter (left) and Bill Miller, assistant manager of the woodlands division for National

Natcon Nursery, a new 5-million tree pine seedling nursery, designed to add more reserves to Florida's timber supply and aid nature in restocking idle forest acres, has been dedicated by National Container. Developed by National Turpentine & Pulpwood Corp., wholly owned subsidiary of National, Natcon Nursery, located near Lake Butler, Fla., will assure a perpetual flow of raw material to National's mills, according to National's officers. The new nursery will become an integral part of Florida's reforestation program by providing enough seedlings annually to plant 7000 acres of the 238,000 acres of Florida land owned by National and devoted to pulpwood production.

Olin

N. H. Collisson of Pisgah Forest, M. C., and M. F. Meissner of East Alton, Ill., have been appointed vice-presidents for operations of Olin Industries, Inc., to assist F. S. Elfred, executive vice-president, in the administration of the company's various divisions. The announcement was made by J. M. Olin, president.

Mr. Collisson, who has been general manager of the Olin Cellophane Division, Pisgah Forest, since 1951, will, as vice-president for operations, administer the Film, Paper, Forest Products and Electrical Divisions. The Film Division is the former Olin Cellophane Division and the Paper Division is the former Ecusta Paper Division.

Mr. Meissner, who has been general manager of the Metals Division with headquarters at East Alton, as vice-president for operations, will administer the Arms and Ammunition, Explosives, Ramset, and Metals Divisions. He will also act as general manager of the Metals Division.

Alaska Pine

Alaska Pine & Cellulose Ltd. has announced the new location of its administrative offices. Effective Dec. 31, 1953, the address of the head office of the company is: Alaska Pine Building, 1111 Georgia St., Vancouver 5, B. C.

K-C

A new improved version of Kimwipes industrial wiping tissues began rolling off production lines in January at Kimberly-Clark Corp. in Neenah, Wis. The new product, now called Kimwipes Disposable Wipes, has been made almost completely lint-free by virtue of a new manufacturing process. At the same time, an improved package of heavier material has been designed which Kimberly-Clark spokesmen say is far more convenient. It prevents waste by serving one wiper at a time and has a more efficient dispensing opening which eliminates any fumbling. A new tab "hang-up" feature permits cartons to be conveniently hung near workers.

New Haven Board & Carton

On Dec. 1, 1953 the New Haven Pulp and Board Co., New Haven, Conn., changed its name to the New Haven Board & Carton Co. The company has grown considerably and has entered a new field beyond the original conception when it was founded in 1900 and incorporated in 1901. The company at that time employed approximately 35 people and produced about 30 tons of paperboard a day. Today with its subsidiaries, it employs approximately 1200 people and now produces over 300 tons of paperboard a day.

In 1917 the company bought the La Have Pulp Co., Ltd., New Germany, Nova Scotia, which has an annual output of over 2000 tons of extremely high-grade mechanical ground wood pulp. However, it has always consumed the production from this mill, and has never actively sold pulp.

In 1937 the company entered the folding carton business in New Haven and in 1945, the controlling interest in its subsidiary, the Bartgis Brothers Co., Ilchester, Md., was purchased. Since then, many improvements have been made and modern equipment has been installed, such as five-color Cottrell rotary letterpresses.

Forest Products Laboratory

The U. S. Forest Products Laboratory has combined paper, resin, and a veneer made from wood commonly left in the woods as waste into a ceiling panel that is uniquely decorative and, according to acoustical tests, has sound-absorption properties similar to those of perforated acoustic tile.

The new ceiling panel is made of paper treated with synthetic resins to strengthen and waterproof it and made into a -in. thick honeycomb to which are glued thin facing panels of Douglas-fir white-pocket veneer.

iling panel of white-pocket Douglas-fir veneer over honeycomb core

White pocket is the common name for a condition in the artwood of overmature Douglas-fir in which the wood is tted with minute holes or pitted with a highly decorative ite substance. Large stands of such trees exist in the cific Northwest.

nishing the ceiling at the Forest Products Laboratory

he acoustic ceiling is the most recent product of the oratory's long-range research to develop uses for this erial. Two Laboratory offices have been equipped with e ceilings, with remarkable sound-deadening effects. holes and white pockets not only kill off ceiling echoes but te a decorative appearance similar to that of pecky cypress, her pitted wood long used for paneling.

he holes add to the acoustic value of the panel because f allow sound to pass through the face panel into the ycomb core, where it is absorbed and deadened.

PCO

he promotion of Gerald E. Veneman to the position of ral sales manager of Nekoosa-Edwards Paper Co., Port Edwards, Wis., was announced by John E. Alexander, president and general manager.

Alexander stated that A. C. Remley, vice-president in charge of sales, will continue as head of the company's sales department. C. A. Schiebler will continue in his present position as assistant general sales manager and L. A. Gardiner as assistant sales manager.

Riegel

Riegel Paper Corp. at Milford, N. J., has recently purchased a new Hydrabeater—combination pulper-refiner for the reduction of wet-strength papers and glassine broke.

Constructed entirely of stainless steel, this Hydrabeater, a 2000-lb. size, features Duotrol—automatic adjustment of the pulping and refining element of the machine.

National Vulcanized Fibre

The National Vulcanized Fibre Co., Wilmington, Del., announces the appointment of H. H. Street as plant manager of the company's Yorklyn, Del., plant. Mr. Street formerly was assistant plant manager.

A plan for enlargement of manufacturing facilities and product development at the National Vulcanized Fibre Co., Wilmington, Del., has been announced by E. R. Perry, president. Part of the plan involves organization of a new development and research department devoted to improvement of company products, solving of chemical problems, and development of new materials for manufacturing. The new program also includes a half-million dollar building and facilities expansion project at the company's Phenolite plant in Kennett Square, Pa. In addition, studies of fiber and paper manufacturing processes at National's Yorklyn and Newark, Del., plants are being made for the purpose of formulating improvement plans at those plants.

Parsons

A study on the efficient making and maintaining of business, professional, and government records of all kinds has been published by the Parsons Paper Co., Holyoke, Mass., in a copyrighted booklet titled "How to Get What You Need in Record Keeping Papers and Index Papers and Index Cards." The booklet covers these subjects: (1) how to organize and maintain a program of adequate records; (2) how to buy forms of all kinds; (3) what kinds of paper or card stock are necessary for various types of forms; (4) how long various types of business and professional records should be kept.

Apprentice Training

Selected Bibliography for Apprentice Related Training Programs, prepared by Fred J. Hartman, Educational Director, International Graphic Arts Education Association

I. General Texts:

1. *The Practice of Printing*, Ralph W. Polk, Chas. A. Bennett Co., Inc., 237 North Monroe St., Peoria, Ill. (1952).
2. *General Printing*, Cleeton and Pitkin, McKnight & McKnight Publishing Co., Bloomington, Ill. (1953 ed).
3. *Graphic Arts Procedures*, R. Randolph Karch, American Technical Society, Chicago 37, Ill. (1949).
4. *Exploring the Graphic Arts*, Maranascio and Osburn, International Textbook Co., Scranton 9, Pa. (1944).
5. *Safety Manual for the Graphic Arts Industry*, Education Council of the Graphic Arts Industry, Inc., 719–15th Street, N. W., Washington 5, D. C.

II. History:

1. *A History of Printing*, John Clyde Oswald, D. Appleton & Co., New York, N. Y. (1928).
2. *The Invention of Printing in China and Its Spread Westward*, Thomas Francis Carter, Columbia University Press, New York, N. Y. (1925).

3. *The Book: The Story of Printing and Book Making*, Douglas C. McMurtrie, Oxford University Press, New York, N. Y. (1948 ed).
4. *Printing Types: Their History, Forms and Use*, Daniel Berkeley Updike, Harvard University Press, Cambridge, Mass., 2 vols. (1951 ed).
5. *The Book in America*, Hellmut Lehman-Haupt, R. R. Bowker & Co., New York, N. Y. (1951).
6. *Printers and Printing*, David Pottinger, Harvard University Press, Cambridge, Mass. (1951).

III. Composition:

1. *Hand Composition*, Hugo Jahn, John Wiley & Sons, New York, N. Y. (1931).
2. *Elements of Composition*, International Typographical Union, Indianapolis, Ind. Unit 1 of I.T.U. *Lessons on Printing* (1945).
3. *Display Composition*, International Typographical Union, Indianapolis, Ind. Unit 2 of I.T.U. *Lessons on Printing* (1945).
4. *Job Composition*, International Typographical Union, Indianapolis, Ind. Unit 3 of I.T.U. *Lessons on Printing* (1945).
5. *Newspaper Practice*, International Typographical Union, Indianapolis, Ind. Unit 4 of I.T.U. *Lessons on Printing* (1945).
6. *Linotype and Intertype*, International Typographical Union, Indianapolis, Ind. Unit 8, I.T.U. *Lessons on Printing* (1946).
7. *Theory and Practice of Composition*, U. S. Government Printing Office, Washington, D. C. (1950).
8. *Printing-Composing Room*, John C. Heineke and George W. Mullenhoff, Delmar Publishers, Inc., Albany 1, N. Y. (1949).
9. *Typography and Design*, U. S. Government Printing Office, Washington, D. C.
10. *A Composition Manual*, Printing Industry of America, Inc., 719—15th St., N. W., Washington, D. C. (1953).

IV. Plate Making:

1. *Commercial Engraving and Printing*, Charles W. Hackleman, Commercial Engraving and Printing Co., Indianapolis, Ind. (1924).
2. *Manual of Stereotyping*, Joseph Dudley Goggins, Kable Bros. Printing Co., Mt. Morris, Ill. (1935).
3. *Photography and Plate Making for Lithography*, Irene Sayre, Lithographic Textbook Co., Chicago, Ill. (1947).
4. *Process Photography and Plate Making*, J. S. Mertle, Cramer Dry Plate Co., St. Louis, Mo. (1947).
5. *Offset Plate of Various Kinds*—a complete series of manuals available from the Lithographic Technical Foundation, New York, N. Y.

V. Photo-Engraving:

1. *The Process and Practice of Photo-Engraving*, Harry A. Groesbeck, Doubleday, Page & Co., Garden City, N. Y. (1924).
2. *Art and Technique of Photoengraving*, Julien J. Soubiran, Horan Engraving Co., New York, N. Y. (1946).
3. *Modern Photoengraving*, Louis Flader and J. S. Mertle, Modern Photoengraving Publishers, Chicago, Ill. (1948).

VI. Presswork:

1. *Elemantary Platen Press*, Ralph W. Polk, Charles A. Bennett Co., Peoria, Ill. (1931).
2. *Handbook for Pressmen*, Fred W. Hoch, Fred W. Hoch Associates, 461—8th Ave., New York 1, N. Y. (1946).
3. *Practice of Presswork*, Craig R. Spicher, Marshall's, Downers Grove, Ill. (1929).
4. *Theory and Practice of Presswork*, U. S. Government Printing Office, Washington, D. C.
5. *Printing—Presswork*, John C. Heineke and George W. Mullenhoff, Delmar Publishers, Inc., Albany 1, N. Y. (1949).
6. *Platen Press Operation*, George J. Mills, Carnegie Institute of Technology, Schenley Park Pittsburgh, Pa. (1953).

VII. Feeders and Their Uses (*see* Texts on Presswork):

VIII. Paper:

1. *Paper Making. The History and Techniques of an Ancient Craft*, Dard Hunter, Albert A. Knopf, New York, N. Y. (1947).
2. *The Characteristics and Functions of Printing Papers*, Jack W. Taylor, Tulsa, Okla. (1950).
3. *Practical Paper Technology*, N. J. and W. B. Wheelwright, Cambridge, Mass. (1951).
4. *The Dictionary of Paper*, American Pulp and Paper Association, New York, N. Y. (1950).
5. *Paper Cutting: Machines and Techniques*, George J. Mills, Carnegie Institute of Technology, Pittsburgh, Pa. (1949).

IX. Inks:

1. *Printing Inks: Their Chemistry and Technology*, Carleton Ellis, Reinhold Publishing Co., New York, N. Y. (1940).
2. *Pressman's Ink Manual, Bullinger's Guide*, New York, N. Y. (1952).
3. *Pressman's Ink Handbook*, Herbert J. Wolfe, Dorland Books Co., 175 Fifth Ave., New York, N. Y. (1953).
4. *Printing and Litho Inks*, Herbert H. Wolfe, Dorland Books Co., 175 Fifth Avenue, New York, N. Y. (1949).
5. *Inks for Offset Lithography*, Lithographic Technical Foundation, Inc., New York, N. Y. (1948).

X. Rollers:

1. *Modern Printing Rollers*, Ernest F. Trotter, Walden Sons and Mott, Inc. (1940).
2. *Platen Press Operation*, George J. Mills, Carnegie Institute of Technology, Schenley Park Pittsburgh, Pa (1953), Chapter XVI, Inking Rollers.
3. *Care and Use of Printers Rollers*, prepared and published by Research and Engineering Council of the Graphic Arts Industry, 719—15th St., N. W., Washington 5, D. C (1953).

XI. Imposition:

1. *Imposition and Lockup*, International Typographical Union, Indianapolis, Ind. Unit 7, I.T.U. *Lessons on Printing* (1940).
2. (*See* General Texts.)
3. *Layouts for Imposition*, U. S. Government Printing Office, Washington, D. C. (1950).

XII. Binding:

1. *A Course in Bookbinding for Vocational Training*, E. W. Palmer, Kingsport Press, Kingsport, Tenn. (1950).
2. *General Bookbinding*, Chris. H. Groneman, McKnight and McKnight, Bloomington, Ill. (1946).
3. *The Binding of Books*, Perry and Baab, Charles A. Bennett Co., Peoria, Ill. (1940).
4. *Theory and Practice of Bookbinding* (Apprentice Training Series), U. S. Government Printing Office, Washington, D. C. (1950).

XIII. Color Printing:

1. *Printers' Art of Color*, Faber Birren, Crimson Press, Westport, N. Y. (1945).
2. *A Color Notation*, A. H. Munsell, Munsell Color Co., Baltimore, Md. (1946).
3. *Principles of Color and Color Mixing*, Jacques H. Bustanoby, McGraw-Hill Book Co. (1947).

4. *Dictionary of Color*, Maerz and Rea, McGraw-Hill Book Co., New York, N. Y. (1930).
5. *Color for Profit*, Louis Checkin, Leveright Publishing Corp., 386 Fourth Ave., New York, N. Y.

XIV. Offset:

1. *Lithographic Manual*, Walter G. Soderstrom, Waltwin Publishing Co., New York, N. Y. (1951).
2. *How to Prepare Art and Copy for Offset Lithography*, Stevens and McKinven, Dorval Publishing Co., Maywood, N. J. (1949).
3. *Complete Lithographic Library* (a list of over 60 authoritative books on all phases of Lithography). Write for complete list of titles to Lithographic Technical Foundation, 131 E. 39th St., New York 16, N. Y.

XV. Gravure:

1. *Elements of Photogravure*, Colin N. Bennett, American Photographic Publishing Co., Boston, Mass. (1935).
2. *Photogravure*, H. Cartwright, American Photographic Publishing Co., Boston, Mass. (1939).
3. *Commercial Rotogravure Printing and Champlain Rotogravure Presses*, Technical Trade School, Pressman's Home, Tenn. (1949).
4. *Gravure Manual*, M. R. Pellissier, Intaglio Gravure Co., Toronto, Canada.

XVI. Silk Screen:

1. *Silk Screen Printing Process*, Biegeleisen and Busenbark, McGraw-Hill Book Co., New York 18, N. Y. (1941).
2. *Silk Screen Color Printing*, Harry Sternberg, McGraw-Hill Book Co., New York 18, N. Y. (1942).
3. *Modern Silk Screen*, Victor Strauss, Pied Piper Press, New York, N. Y. (1950).
4. *Silk Screen for Beginners*, James Eisenberg, McKnight and McKnight, Bloomington, Ill.

II. Make-Ready: Theory and Practice:

P.I.A. Portfolio on Makeready and Pre-Makeready, Printing Industry of America, 719–15th St., N. W., Washington 5, D. C.

Proceedings of the First Conference on Makeready and Pre-Makeready, Research and Engineering Council of the Graphic Arts Industry, 719—15th St., N. W., Washington, 5, D. C. (1953).

EARCH

t a St. Louis, Mo., Chamber of Commerce Luncheon ntly, Sidney D. Kirkpatrick vice-president of McGraw- Publishing Co., spoke on "A Challenge in Dynamics." is talk Kirkpatrick pointed out the reason for the dynamic wth in the chemical industry is the fact that it spends e for research than any other industry group. Since arch is the motivating force behind this phenomenal wth in the chemical industry, he said, "the future prosy of the chemical industry, if not the country, is pretty h in our hands." The chemical industry should be ding on research at least one sixth as much as it is spendon capital expenditures for new plants and equipment. e chemical industry does not progress, it retrogresses.

irkpatrick stated that as go capital expenditures, so goes perity. Except for wartime, there never has been a d during our modern industrial development when al expenditures were high that there was not a period of ral prosperity. Conversely, when capital expenditures lown, there has generally been a business depression. use of this, his company has surveyed industry plans for . They have come up with a total projected capital nditure for 1954 of $11,683,000,000. This compares $12,960,000,000 for 1953.

n our industries continue to grow as they have in the past? Kirkpatrick pointed out that the population trends have been neglected in most of our research. During the past 10 years our total population has been increasing almost three times as fast as in the preceding 10 years. In most metropolitan centers the population is doubling every 200 years, while in the St. Louis area the population is doubling every 59 years.

This population trend will have a profound influence on capital expenditures. The country must double its power supply in the next ten years. Sales of the chemical industries have been doubling each ten years and capital expenditures have been increasing at a like rate.

Research underlies the unique dynamicism of the chemical industry, he said. For management endowed with courage and resources, research can yield handsome dividends. However, there is nothing static about chemical products, processes, and production techniques. Chemical plants live constantly in the shadow of obsolescence. This is the chief challenge of dynamics in the chemical industry.

Research Man Power and Costs

The United States Department of Labor recently announced the availability of a report entitled "Scientific Research and Development in American Industry" prepared by the Bureau of Labor Statistics based on the finding of a survey conducted during 1952 by the Research and Development Board of the Department of Defense. Perhaps the best way to describe the report is to quote, as follows, from its introduction:

"Research and development in industry is by far the largest segment of the Nation's scientific research activity. In 1952, the national expenditures for scientific and engineering research and development totaled about $3^3/_4$ billion dollars, of which about $2^1/_2$ billion was for work done in laboratories and other facilites owned or operated by private industry. Both the total national outlay and the cost of the research performed by private business were more than 40% higher in 1952 than in 1949—owing primarily to the emphasis on military technology which has characterized the current program of partial mobilization but also in part to the needs of an expanding civilian economy.

"The demand for scientific and engineering personnel and research facilities arising from both these sources created a need for more information about private industry's huge research resources, comparable to that already available regarding the much smaller research operations of universities and Government agencies. More accurate estimates were needed of the total national cost of industrial research, the amount of research performed by different industries, and the number of research engineers and scientists employed in these industries. Information on the cost of research per worker employed was also needed for use in estimating man-power requirements and determining whether proposed projects were feasible in view of the available resources of scientific and technical personnel. Other questions in which there was widespread interest were the extent of employment of supporting personnel and the effect on research staffs of calls to military service and other types of turnover.

"In order to obtain information on these and related questions, the Research and Development Board conducted in mid-1952 a questionnaire survey of the research and development activities of private companies and nonprofit research agencies (other than colleges and universities). Nearly 2000 concerns, including almost all companies with large research programs, sent in usable questionnaires. These companies employed about $6^1/_2$ million persons and had sold nearly 100 billion dollars worth of goods and services during 1951. The number of firms with small research activities which were not reached by or failed to respond to the survey could not be determined exactly. However, the study covered most of the industrial research and development work in the United

States—probably about 85% of the total, measured in terms of 1951 cost.

"A preliminary report giving highlights of the survey findings was issued at the beginning of 1953. The present report incorporates the data presented in this earlier publication and also includes much additional information, particularly with respect to the cost and employment experience of individual firms. Among the topics covered are the numbers of research engineers and scientists employed on both Government and non-Government work; the employment of supporting personnel; the cost of research performed, on Government prime contracts and subcontracts and under company sponsorship; the relationship of research cost to value of sales; the average cost of research per employee, on Government-financed and company-financed projects; and, finally the turnover rates among research engineers and scientists and the past and potential effects of military calls of such employees.

"Information is presented for different industries and for companies of different sizes. Insofar as possible, the varying experience of individual companies in the same industry and size group is also analyzed."

Identified as U. S. Department of Labor, Bureau of Labor Statistics, Bulletin 1148, the report may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 50 cents per copy.

Engineering and Over-all College Enrollments Fall 1953

Following are the U. S. Office of Education estimates of over-all college enrollment and engineering college enrollment during the Fall of 1953 as compared with 1952 and prior years.

Year	*All college students*	*All freshmen*
Fall of 1953	2,274,000	577,000
Fall of 1952	2,148,000	537,000
Ratio 1953 to 1952	106%	107%

The figures for engineering enrollments are as follows:

Year	*Total undergraduates*	*All freshmen*
1953	191,700	60,200
1952	156,100	51,600
Ratio 1953 to 1952	123%	118%

The prewar average of engineering freshmen expressed as a percentage of all freshmen was 8%. The corresponding ratios for the last four years are as follows:

1950—6.6% 1952— 9.7%
1951—8.5% 1953—10.5%

The above figures represent all engineering enrollment, in accredited as well as nonaccredited curricula. It is interesting to note that there has been an 18% increase over 1952 in engineering freshmen enrollments compared to a 7% increase over 1952 in over-all freshmen enrollments. If current survival rates apply, about 30,000 will graduate from accredited engineering curricula in 1957.

An Endorsement

The following was recently transmitted to the Engineering Manpower Commission by Donald S. Bridgman, chairman of the American Society for Engineering Education Manpower Committee.

"On recommendation of the Manpower Committee, the Executive Committee, Engineering College Administrative Council, heartily endorses and supports the recent and current efforts of the Engineering Manpower Commission of Engineers Joint Council as follows:

"1. To combat the apparent policy of the Selective Service System to require military service of all able-bodied youths, regardless of their importance to present or future critical industrial production for defense, through termination of industrial deferments after limited periods and frequent reluctance to grant deferments for graduate work in technical fields, following undergraduate student deferments.

"2. To transfer from the Department of Defense to the Selective Service System or another appropriate civilian agency of the Government, primary responsibility for assignment to military service or other activities in the national interest in the event of an emergency, the great numbers of the country's youth now placed in the armed forces reserves following active military duty, and to prevent the compulsory placing of additional young men in such reserves as the result of certain proposals for universal military training.

"3. To urge upon the bodies responsible for study of proposals for universal military training elimination of training in particular military specialties as a part of such training and the consequent shortening of the training period required for it. Training in such specialties in addition to basic training is likely to be useless in view of the interval before active military duty and continuing changes in military practice. The period required for universal military training, moreover, should be kept to the minimum to lessen its interference with the education and productive employment of the country's youth."

LOWELL TECH

A new approach to the problem of industry-education cooperation was announced recently by the Paper Engineering Department at Lowell Technological Institute following the annual meeting of the Paper Advisory Committee on Research.

Real case problems drawn up by industry members of the committee will be presented to each paper engineering senior to work out during the year. He will be expected to contact industry for advice and assistance in solving his case problem. In order to have each member of the class benefit from all the case problems, each man will be called upon to present to the class several times through the year the progress he has made in solving his case problem. Each man will meet the Advisory Committee and review his project. His report will be reviewed by all members of the committee who will judge the student on his approach to the problem as well as the recommended solution. This new approach will enable industry personnel to evaluate members of the graduating engineering class as well as provide students with real industry problems.

SYRACUSE

The College of Forestry of the State University of New York expects to offer 25 fellowships for the college year 1954–55. Stipends vary from $900 to $1350 for a 9 or a 12 month period. Fellowship holders are excused from paying tuition and laboratory fees of about $350 per year.

Recipients are required to assist in teaching and research work for a maximum of 15 hours per week. Income derived from fellowship awards is subject to Federal Income Tax.

Fellows may pursue studies leading to the Master of Forestry, Master of Science, and Doctor of Philosophy degrees. They may specialize in the following fields of instruction and research: Forest Botany, Forest Entomology, Forest Zoology, Wildlife Management, Silviculture, Forest Management, Forest Mensuration, Forest Administration, Forest Economics, Forest Influences, Photogrammetry Applied to Forestry, Landscape and Recreation Management, Wood Technology, Forest Products Manufacture and Utilization, Pulp and Paper Technology, and Wood and Polymer Chemistry. Specially qualified applicants will be considered for fellowships sponsored by industry, research foundations, and Government agencies which the college awards for work of

assigned research projects. Recipients are required to devote full time, except for course work, to these projects. Conditions of awards vary with sponsorship.

The industrial and other sponsored research fellowships carry stipends from $1500 to $2000. Holders of these fellowships are also excused from paying college tuition and laboratory fees amounting to approximately $350 per year. These fellowships are usually offered in such fields as wood chemistry, polymer and plastics chemistry, pulp and paper technology, wood technology and utilization, preservation, and pathology.

Research fellowships are also awarded in relation to the general program of research of the college. These fellowships cover all fields of forestry offered by the college.

Tuition scholarships for deserving out-of-state students are available in limited number, too. These cover tuition and fees to the amount of $350 per year.

Reliance

E. H. Helm, sales vice-president of Reliance Electric & Engineering Co., Cleveland, Ohio, has announced the following appointments: John H. Drollinger, Jr., has been made manager of the Renewal Parts and Repair Division in Cleveland. William C. Mitchell succeeds Mr. Drollinger as manager of the Toledo Sales Office. Robert O. Gee is appointed manager of service.

Hooker

J. H. Brunn, director of research of the Hooker Electrochemical Co., Niagara Falls, N. Y., has announced that two new chemists, S. J. Nelson and John E. Weir, have been added to the resins and plastics group of the research and development department. Joseph E. Thornberg has been made technical sales service field representative, and Delmont L. Boundy and Henry R. Morrison have been advanced to positions in the sales-production coordination office of the Hooker sales department.

Fiberglas

The Pacific Coast Division of Owens-Corning-Fiberglas Corp., P.O. Box 89, Santa Clara, Calif., has published a brochure describing Fiberglas industrial insulations for use at temperatures from subzero to 1200°F. Also announced is Fiberglas Siding Cushion, for application over existing buildings as an underlay for new siding. This material is available in 200-ft. rolls, 2 ft. wide and $^1/_2$ in. thick. Another Fiberglas product just announced is a low pressure pipe insulation, available with canvas covering or with a black jacket of asphalt-saturated kraft paper.

Fiberglas siding cushion being applied to house

Staley

A. E. Staley, Jr., in a year-end news release, stated that "demand for both food and industrial starches and for corn sweeteners was at a very satisfactory level during the four months through November, 1953. Assuming there is no appreciable decline in general business activity, the demand for corn products should continue at satisfactory levels in 1954, though at a somewhat lower rate than prevailed in the closing months of 1953."

International Nickel

A new ship for carrying liquid chemicals has been built by the Bethlehem Steel Co., to operate between Dow Chemical Co.'s Freeport, Tex., division and Gulf and East Coast ports. Four of the ship's 24 center tanks were designed to carry 73% caustic soda, and involved the use of over 685,000 lb. of nickel-clad steel and 47,000 lb. of pure nickel.

Harris-Seybold

George S. Dively, president of Harris-Seybold Co., Cleveland, Ohio, has announced the firm's acquisition of the assets of C. B. Cottrell & Sons Co., with plants in Westerly, R. I., and Milwaukee, Wis.

Torrington

The Torrington Co., South Bend, Ind., has issued Catalog 61, giving basic technical data for the selection of bearings.

Cavitron

Cavitron Equipment Corp., Long Island City, N. Y., has developed an electronic machine tool for drilling and shaping super-hard materials. The process is based upon inducing extremely high-frequency, low-amplitude vibrations—over $1^1/_2$ million per minute—in a tool or pattern shaped to any desired contour.

Monsanto

The plastics division of Monsanto Chemical Corp., Springfield, Mass., is planning a new research center to serve industries in the plastics field.

Aries

Aries Laboratories, Inc., 270 Park Ave., New York, N. Y., has published a brochure on Aritemp resins.

Langston

Samuel M. Langston Co., Camden, N. J., has announced the appointment of H. Clifford Mayhew as assistant vice-president, and of Edward B. Seeger as sales manager.

U. S. Industrial Chemicals

U. S. Industrial Chemicals Co., 120 Broadway, New York, N. Y., has published a booklet reviewing the properties, preparation, and industrial application of sodium dispersions.

Rohm and Haas

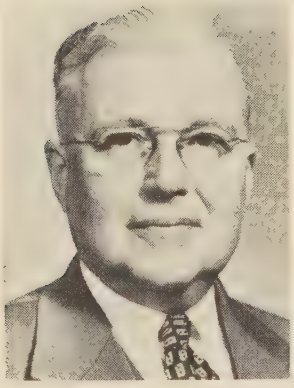
Rohm and Haas Co., Washington Square, Philadelphia 5, Pa., has published a booklet "Amberlite Ion Exchange," which describes ion exchange technology.

B & W

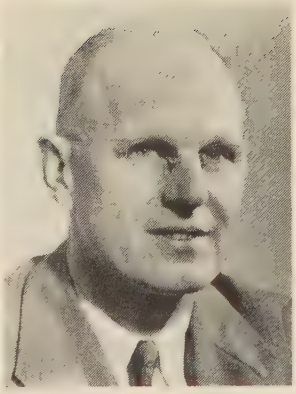
Babcock & Wilcox Co., Beaver Falls, Pa., has issued a bulletin (TDC 160) containing information on the comparative corrosion resistance of stainless steels to corrosive media. E. T. Wilson, Jr., has been appointed tubular products sales representative for B & W in Oregon, Washington, British Columbia, Alberta, and Saskatchewan.

Philadelphia Quartz

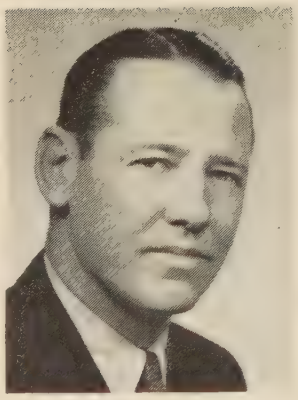
The Philadelphia Quartz Co., Philadelphia 6, Pa., has announced the addition of two new products to its line of soluble silicates—anhydrous sodium metasilicate and sodium ortho-



E. D. Rhodes, F. C. Huyck & Sons



W. Moe, F. C. Huyck & Sons



J. R. Verdon, F. C. Huyck & Sons

K. H. Klipstein, American Cyanamid Co.

silicate, known as Metso Anhydrous and Metso 200. In the December, 1953, issue of *Tappi*, Metso Anhydrous was erroneously referred to as Metso Hydrous.

PERMUTIT

The Permutit Co., 330 W. 42d St., New York, N. Y., has issued a bulletin (No. 2204B) on the Permutit Precipitator.

The Lancaster plant of the Permutit Co.

Permutit is building a metal-working plant at Lancaster, Pa., scheduled for completion by the Spring of 1954.

HUYCKFELT

Earl D. Rhodes has been elected a vice-president of F. C. Huyck & Sons, Rensselaer, N. Y. Wilhelm Moe is now general superintendent of the company's Rensselaer plant, and James R. Verdon has been appointed to the felt sales staff.

SWENSON

G. E. Seavor, vice-president (sales), Swenson Evaporator Division, Whiting Corp., Harvey, Ill., has announced the following appointments: Harvey K. Waters is assigned to the Birmingham, Ala., district sales office, and George Kleinman is assigned to the Houston, Tex., district office.

CYANAMID

K. C. Towe, president of American Cyanamid Co., New York, N. Y., has announced the following changes in the managerial organization of the company: Kenneth H. Klipstein is appointed general manager of the newly created research division of the company; L. C. Duncan is general manager of the new organic chemicals division, of which V. E. Atkins is assistant general manager; A. B. Clow becomes general manager of the fine chemicals division, with A. R. Loosli as assistant general manager; J. Allegaert is appointed general manager, and A. B. Hettrick assistant general manager of the new pigments division. J. T. Thurston will be responsible for the operation of the Stamford research laboratories.

RAYBESTOS-MANHATTAN

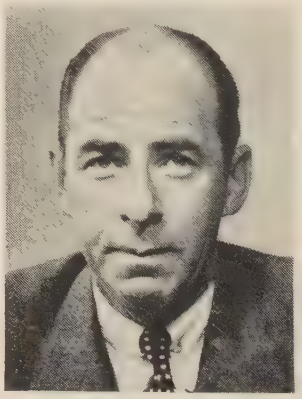
Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J., has announced the XDC conveyor belt, for which superior abrasion and tearing resistance is claimed. Also announced is a new V-belt for which a horsepower capacity of 40% over standard V-belts is claimed.

HERCULES

Russell H. Dunham, the first president and former chairman of the board of Hercules Powder Co., Wilmington, Del.,

L. C. Duncan, American Cyanamid Co.

A. B. Clow, American Cyanamid Co.



J. Allegaert, American Cyanamid Co.

J. T. Thurston, American Cyanamid Co.

etired from active service with the company at the end of 953, after 51 years of service.

New appointments in the Hercules Synthetics Department ales division were announced recently as follows: F. H. rymes, district manager in Chicago; W. F. Power, district anager in San Francisco; F. W. Beavers, district manager in incinnati.

During 1953, Hercules noted a constantly increasing variety f end uses for its products.

.E.

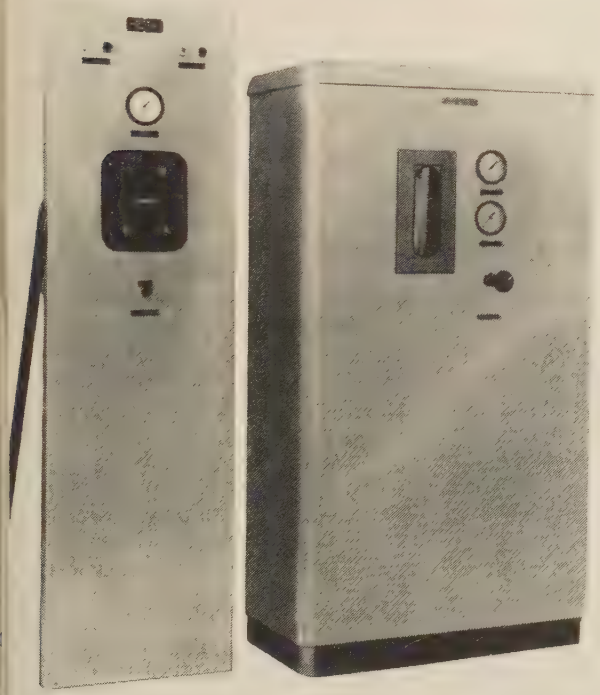
The General Electric Co., Schenectady, N. Y., has pubished the following bulletin: GEA-4053 describing amplidyne ystems; GEC-979A on portable d.c. indicating instruments; EA-5712 on sectional drives for paper machines; GEC-005E a catalog of Calrod heaters; G.E. has announced a ew portable recording volt-ammeter, designated type CF-7, nd a new butyl-molded current transformer for outdoor apications up to 5000 volts.

NDSAY

Lindsay Wire Weaving Co., Cleveland, Ohio, celebrated 50th anniversary with a dinner dance at the Hotel Statler Dec. 5, 1953.

SCHER & PORTER

Fischer & Porter Co., Hatboro, Pa., has issued the first ree of a series of bulletins on pulp and paper industry apications, viz., Density Measurement and Control (90-130-), Liquid Level Measurement and Control (90-130-12), l Measurement of Stock Flow Rate (90-130-13).

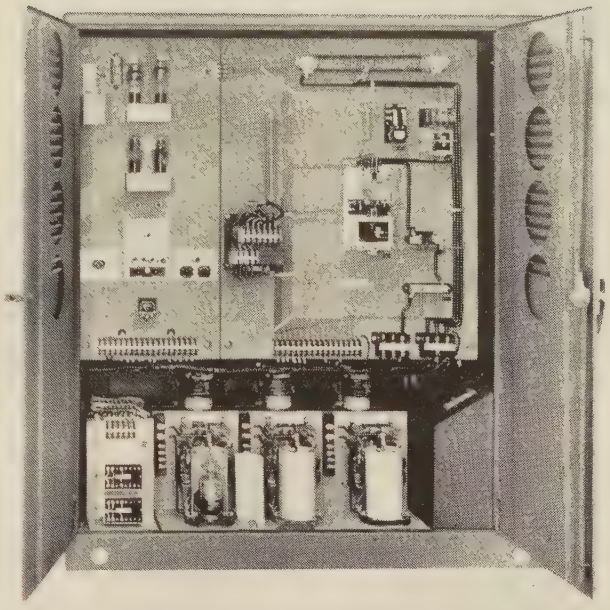


new Fischer & Porter high capacity chlorinators

. & P. has announced a new line of high-capacity chlorina, designated as Figure 1052 Rotochlor, capable of hang up to 6000 p.p.d. with either manual or automatic proioning.

IANCE

eliance Electric & Engineering Co., Cleveland, Ohio, has ounced a new mercury rectifier variable-voltage power



*The Reliance Xatron V*S drive*

drive, designated the Reliance Xatron V*S Drive. Also announced is a new line of Reliance protected and enclosed squirrel-cage induction motors for all industrial purposes. C. V. Gregory has been promoted to the newly created position of manager of district sales for Reliance.

DORRCO

John V. N. Dorr, chairman, and J. Delano Hitch, Jr., president of the Dorr Co., Stamford, Conn., announce the promotion to the vice-presidential level of five senior department heads, viz.: Frank H. Conover, Harold B. Coulter, John D. Grothe, Douglas C. Reybold, and Elliot J. Roberts.

NEWPORT NEWS

William E. Blewett, Jr., has been elected president of the Newport News Shipbuilding and Dry Dock Co., Newport News, Va. Mr. Blewett succeeds J. B. Woodward who retired recently after nearly 40 years of service. N. L. Rawlings is now executive vice-president and general manager, and R. I. Fletcher becomes financial vice-president. Newport News is currently building the 1040-ft. aircraft carrier *Forrestal*.

FOXBORO

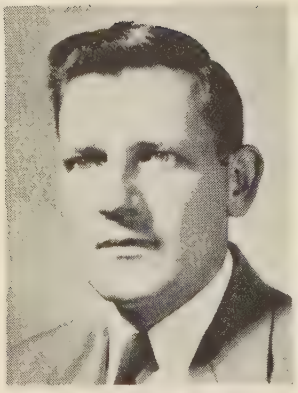
The Foxboro, Co., Foxboro, Mass., has published a technical report, TI-27-A-16B, covering a system which accurately measures viscosity under industrial conditions.

GENERAL MILLS

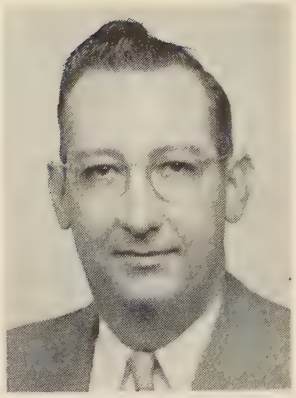
General Mills Research Laboratories, 2010 E. Hennepin, Minneapolis, Minn., has announced a new polyamide resin-epoxy resin paper coating, claimed superior to acetate laminations and much cheaper.

EARL

Earl Paint Corp., 240 Genesee St., Utica, N. Y., has announced a new synthetic rubberized coating, Erchlor 1900, developed to meet those plant conditions where the ordinary lines of chlorinated rubber finish have not been sufficiently resistant to withstand severe corrosive conditions. Earl's Erkote 1807 Quick Drying Chromate Primer is recommended for retarding underfilm corrosion in conjunction with any type of finish coating.



E. F. Wagner, Witco Chemical Co.



J. H. Pearson, The Black-Clawson Co.

WITCO

Edward F. Wagner has been appointed manager of the Chicago plant of Witco Chemical Co., New York, N. Y. Dr. Wagner will continue to serve also as director of the technical service dept. W. B. Pings becomes assistant director of technical service and retains his position as director of the plant laboratory.

DELRAC

Delrac Corp., Watertown, N. Y., has been appointed distributor of Polyken Protective Tape, manufactured by Bauer & Black Division of the Kendall Co., according to a recent announcement by Delrac's president, Carl F. Richter.

B-C

Recently returned to this country after spending several months with the operating personnel of Sweden's first American-type folding boxboard mill, Wm. A. White, Jr., and John H. Pearson, engineers of the Black-Clawson Co., report that the new board mill of Fiskeky Fabriks Aktiebolag at Norrkoping, Sweden, is now in production and operating smoothly.

DU PONT

Chief Judge Paul Leahy in U. S. District Court in Wilmington held on December 14 that the Government's complaint in the cellophane antitrust suit should be dismissed. The complaint, filed Dec. 13, 1947, charged that du Pont monopolized, and combined and conspired to monopolize, the sale of cellophane and of cellulose caps and bands.

Judge Leahy stated as his conclusion of law:

"The facts destroy the charges here made. There has been no monopolization or conspiracy or combination or attempt to monopolize shown. The record reflects not the dead hand of monopoly but rapidly declining prices, expanding production, intense competition stimulated by creative research, the development of new products and uses and other benefits of a free economy. Neither du Pont nor any other American company similarly situated should be punished for its success. Nothing warrants intervention of this court of equity. The complaint should be dismissed."

The history of du Pont's cellophane business, Judge Leahy said, "is a record of competitive achievement." He observed that du Pont was the first American manufacturer, and that its pioneering "required foresight, and a willingness to take risks." Du Pont, he said, had little technical experience in this line, the product had not been proved as a packaging material, and had little acceptance in this country. Thus, du Pont entered the business in the only practicable manner, acquiring the commercial process from the French on the best terms it could negotiate.

At first, product, process, costs, and distribution all presented problems, and "only by effective competition could du Pont hope to gain recognition for its product in markets where other materials were entrenched. The business had to be built up by creative research."

Judge Leahy noted that the French product did not meet the demands of the American market. Du Pont invented a new product, moistureproof cellophane, patented the product, and "then exploited that patent, well within the purposes and intentions of the patent grant.

"As cellophane got recognition in the trade," Judge Leahy said, "others entered various phases of the business as converters, users, suppliers of raw materials, manufacturers of equipment, and the like. Cellophane creates competition. Throughout the flexible packaging markets this competition is felt. It stimulates efforts of other producers to manufacture more efficiently. It stimulates research. The consumption of flexible packaging materials including cellophane has grown at a rapid rate. Within these markets the competition is intense. New producers have entered. No one material or one supplier controls—certainly not du Pont, which has neither the power to raise prices nor to exclude competitors.

"After reviewing the development of this business, plaintiff has been unable to bring a single person who says he was injured or who claims to have been denied an opportunity to participate. Prices have consistently been lowered and reflect competitive pressures. Production has expanded. Benefits from research have been passed on to consumers. Du Pont has not conducted its cellophane business in a restrictive way. There are no artificial controls which it can exercise in the markets where its product is sold."

Judge Leahy made 854 findings of fact. Among these were many detailed findings that cellophane competes with other flexible packaging materials in a wide variety of specific uses. He also found that du Pont competed by research to improve quality and to lower cost, and that du Pont competed by lowering prices.

"The record," he said, "establishes plain cellophane and moistureproof cellophane are each flexible packaging materials which are functionally interchangeable with other flexible packaging materials and sold at same time to same customers for same purpose at competitive prices; there is no cellophane market distinct and separate from the market for flexible packaging materials; the market for flexible packaging materials is the relevant market for determining nature and extent of du Pont's market control; and du Pont has at all times competed with other cellophane producers and manufacturers of other flexible packaging materials in all aspects of its cellophane business."

Judge Leahy said that the "master factual questions" in determining whether du Pont had market control, and, hence, monopoly power, were whether du Pont had power to raise the price of cellophane without regard to competitive forces, and whether du Pont had power to exclude competition.

As to power to raise price, he said "du Pont could not have developed volume of cellophane business without lowering its prices." He found that competitive influences place limitations on du Pont's pricing policies and procedures. Also, he said, there was no evidence of collusion fo fix cellophane prices, but price identity occurred as a result of competitive factors. "Sylvania, du Pont's competitor," he said, "was obliged to charge prices comparable to du Pont in order to remain competitive .... The prices du Pont charged were prices which it was obliged to charge as a result of the competitive conditions in the market."

As to power to exclude competitors, Judge Leahy said du Pont had no corner on raw materials or technology, and did not control channels of distribution. There was no evidence, he said, that any existing competitor was eliminated, and the Government failed to prove that any potential competitors were excluded.

Turning to du Pont's moistureproof patent, Judge Leahy said that; "This is the first monopoly case where the owner of

a product patent has been accused of having monopolized the patent product of his own invention." The valid product patent, he said, "represents a defense to the monopoly charge."

"I am able," Judge Leahy said, "after critical examination of the record, to determine du Pont's position is the result of research, business skill, and competitive activity."

Judge Leahy found that du Pont's original agreement with the French was lawful, and not, as the Government contended, part of a scheme to divide world markets. In subsequent dealings abroad, he said, du Pont refused to divide territories—"it competed vigorously." Also, "in every market where du Pont sold, it fought the cartel group."

Judge Leahy rejected the Government's contention that du Pont's position was maintained by predatory assertion of monopoly power. In this part of its case, the Government accused du Pont of suppressing Sylvania as a competitor; attacked the validity of the du Pont-Sylvania moistureproof license agreement, and charged a conspiracy to fix prices. Judge Leahy found that Sylvania expanded to the full extent of its financial abilities; that the license agreement was valid and not only did not restrict Sylvania's production, but that Sylvania could not have competed at all without a license from du Pont; and that there was no conspiracy to fix prices.

The Government also had pointed to a group of patent license agreements as "predatory practices." Judge Leahy examined these one by one, concluding, "It is difficult to see how the few instances to which plaintiff directs its criticism can serve to support the contentions du Pont's patent practices evidenced the intentional predatory assertion of monopoly power."

Of the charge that du Pont controlled distribution outlets, Judge Leahy said, "This phase of plaintiff's predatory practice case has been difficult to understand." He concluded, "Plaintiff's charges as to the distribution aspect of the case are without foundation in the record."

In a section of the opinion headed "Evidence Plaintiff Ignores," Judge Leahy said, "Plaintiff asks a finding du Pont throughout the 30 years of its cellophane business was motivated by a deliberate unlawful intent. It points to no single transaction to support this contention. It sought to draw from normal business conduct inferences of criminal motive and proof of illegal acts.

"As part of this studied tactic, I cannot ignore the testimony. Witnesses cannot be brushed to one side.

"There were 39 witnesses who testified in this case. Of these, 31 were not employees of du Pont. This group of independent witnesses was principally made up of businessmen from many different parts of the country. They included alleged potential competitors whom plaintiff continues to charge du Pont sought to prevent from going into the business of making cellophane, but who testified categorically to the contrary. They included converters of cellophane, whom plaintiff urges were restricted and controlled by du Pont, but who testified explicitly to the contrary. They included manufacturers of flexible packaging materials whom plaintiff insists do not compete with du Pont, but who explicitly testified to the contrary. They included buyers of materials sold in the flexible packaging markets who testified to conditions in those markets which plaintiff continues to assert do not exist. They included three representatives of American Viscose who denied charges of suppression and conspiracy. Testimony of all witnesses is supported by substantial documentary proof.

"Witnesses from du Pont were called to testify as to questions of motive, purpose, and intent. Testimony of these witnesses stood the acid test of cross-examination. The principal executive of du Pont responsible for the development of cellophane through almost the entire period of the complaint categorically denied plaintiff's charges in general and in particular by explicit testimony, and was not even cross-examined. One of the leading research chemists of du Pont responsible for the largest group of patents in its cellophane portfolio was not even cross-examined. Other witnesses such as Walter Carpenter, a chief executive of du Pont, during the period of cellophane development, were examined perfunctorily.

"To reach inferences which plaintiff seeks this court to draw from its selected use of documentary materials would necessitate a determination by this court the testimony of these witnesses was false. After months of study and critical examination of the Record and recollection of seeing and hearing these witnesses throughout many long trial days, such a conclusion I cannot reach with validity. They were not discredited—in many instances, not even challenged—and such a conclusion is beyond my ken."

As to the charge of monopolization of caps and bands, Judge Leahy noted that du Pont does not make caps, and "encounters intense band competition from both Sylvania and Celon." Also, he said, there is effective competition from manufacturers of "many other types of secondary closures which are functionally interchangeable with du Pont's bands and are used by the same classes of customers for the same purposes."

Pandia

L. G. Durant, vice-president of Pandia, Inc., New York, designers and manufacturers of the Chemi-Pulper continuous digester and auxiliary pulp mill equipment, flew to Japan. January 3 to visit several pulp and paper mills and consult with Pandia's Tokyo representatives. While in Japan, Mr. Durant is to give a talk on "Custom-Made Pulp for Specific Requirements," before the Japanese TAPPI in Tokyo on Jan. 19, 1954. Mr. Durant expects to return to the States by the middle of February, 1954.

Ronald G. Goodwin, director of sales engineering for Pandia flew to Europe on Jan. 7, 1954. Mr. Goodwin is going first to Finland in a consulting capacity concerning one of the Chemi-Pulper continuous digesters which is in operation in that country. He will also consult with Pandia's local representatives and visit numerous pulp and paper mills in Sweden, Norway, Belgium, France, Germany, and Great Britain. Mr. Goodwin hopes to be able to return to this country in the Spring of 1954.

Downingtown

The Downington Manufacturing Co., Downingtown, Pa., has announced the following changes in the sales and engineering departments. Appointed executive vice-president is Harry C. Merritt. Appointed chief engineer is Jack C. Harper. Emerson N. Glauner, Jr., Richard W. Polleys, and Jacob V. Edge have been appointed assistant sales managers. F. L. Wooten is now sales representative, C. H. Mullen and Joseph W. Martin sales engineers.

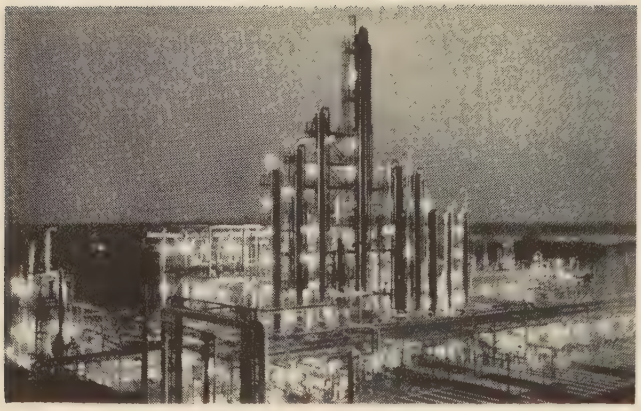
Westvaco

Mr. Louis Neuberg, vice-president, sales, of the Westvaco Chemical Division of Food Machinery and Chemical Corp. has been appointed vice-president of the chemical divisions of the corporation, Ernest Hart, executive vice-president of Food Machinery and Chemical Corp. announced recently.

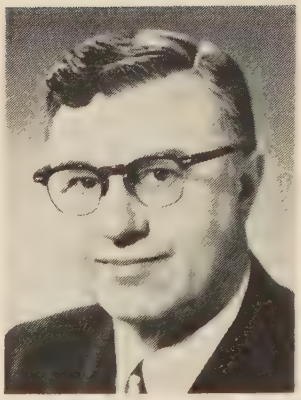
Semet-Solvay

Semet-Solvay Petrochemical Division, Allied Chemical & Dye Corp., announced recently the opening of its new Niagara River Petrochemical Plant at Tonawanda, N. Y., for production of polyethylene products. The ethylene is derived from gas which is produced from fuel oil in equipment designed and erected by Semet-Solvay Engineering Division. This is an innovation in the petrochemical industry, as most plants have been built near natural gas lines.

The ethylene plant was designed and constructed by The



The new Semet-Solvay Petrochemical Division's Niagara plant, Tonawanda, N. Y.



E. C. Lenz, Morningstar, Nicol, Inc.

H. B. Gerber, E. D. Jones & Sons Co.

Lummus Co., and the plant for production of A-C Polyethylene was designed by Semet-Solvay Engineering Division. The processes inherent in the operation of this plant originated in Allied's Central Research Laboratory at Morristown, N. J., and have been further developed by Semet-Solvay, in collaboration with the Central Research Laboratory staff by the operation of a pilot plant at Buffalo. Production is estimated at 20 million pounds annually, which will serve to supply a portion of the rapidly growing market.

KATZEN

Raphael Katzen of 3735 Dogwood Lane, Cincinnati 13, Ohio, has initiated practice as a consulting chemical engineer. Services include assistance in management and engineering planning of new projects, and improvement of existing processes and installations, in the fields of organic chemicals, petro-chemicals, wood chemicals, and waste disposal.

NATIONAL STARCH

Frank L. Murphy has been appointed National Starch Products, Inc., new Pacific Coast division manager. Mr. Murphy is well qualified for the position, having had more than 10 years' experience in manufacturing, technical service, and sales.

ANHEUSER-BUSCH

Tate M. Robertson, Jr., sales manager of the Corn Products Dept. of Anheuser-Busch, Inc., St. Louis, Mo., has announced the appointment of Arthur F. Moeslein to division sales manager of the central and southern states territory.

CARBORUNDUM

Agreement has been reached for the Carborundum Co. to acquire the capital stock of the Stupakoff Ceramic and Manufacturing Co. of Latrobe, Pa., according to an announcement by Clinton F. Robinson, president of Carborundum in Niagara Falls, N. Y. General Robinson said Stupakoff Ceramic and Manufacturing will continue operations under its present name and the present organization and personnel of Stupakoff will be retained under the direction of Semon H. Stupakoff, president of the company.

MORNINGSTAR, NICOL

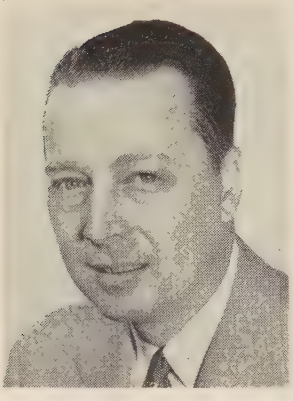
Earl C. Lenz, formerly vice-president and general sales manager of Paisley Products, Inc., subsidiary of Morningstar, Nicol, Inc., has been elected vice-president of sales and advertising for the parent company and all its subsidiaries. The appointment was announced by the firm's president, George J. Muller.

E. D. JONES

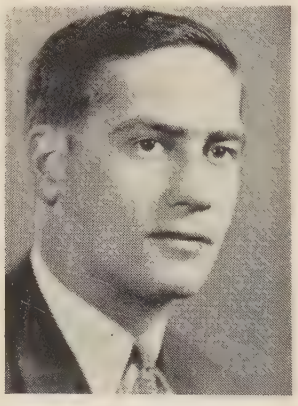
Howard B. Gerber has been appointed sales representative for E. D. Jones & Sons Co., manufacturers of stock preparation equipment. His territory will be all the West Coast states and British Columbia.

NAUGATUCK

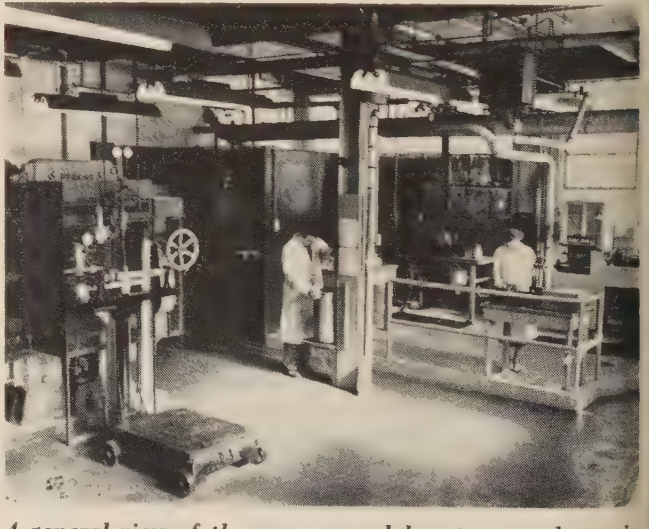
Naugatuck Chemical Division, United States Rubber Co., has established a paper laboratory and begun a research program aimed at developing new products for the paper industry.



A. F. Moeslein, Anheuser-Busch, Inc.



F. L. Murphy, National Starch Products, Inc.



A general view of the new paper laboratory at the main plant of the Naugatuck Chemical division, United States Rubber Co., in Naugatuck, Conn.

Coatings that will improve grease resistance, solutions that ill increase wet strength, binders that will make better rinting bases, and many other products are being tested or ought in the new laboratory located at the main plant of the hemical division in Naugatuck, Conn.

Utility Tool and Body

A tool for tree girdling to ease the work of peeling and cull-g is being marketed by Utility Tool & Body Co. of Marion, is. Called the "Handi-Girdler," it cuts a 3-in. band of ark by means of pressure applied by hand with a short piece pipe. The tool weighs 2 lb. and is about 12 in. long.

Eastwood-Nealley

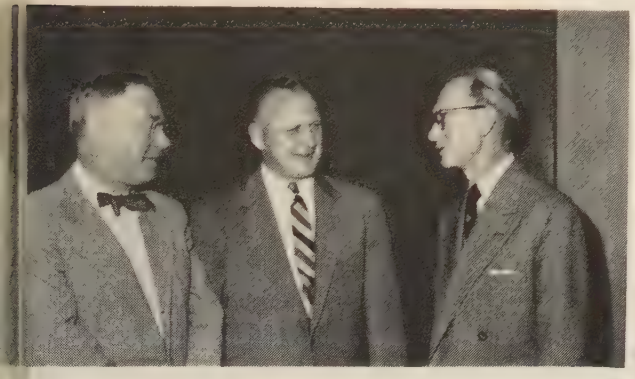
The Eastwood-Nealley Corp., Belleville, N. J., manufac-rer of fourdrinier wires and wire cloth, announces the ap-intment of Thomas B. Scarfone as western sales representa-ve covering California, Oregon, Washington, and Idaho.

Albany Felt

Invited by the Albany Felt Co. to talk before the semi-nual technical sales meeting on the subject "Relation of lt Performance to Paper Machine Efficiency" at Albany Dec. 3, 1953, a representative of the fine papers, high-grade ding box, and kraft branches of the paper industry dis-ssed the various phases of felt application in their respective

na Westcott, West Virginia Pulp & Paper Co.; Harry dley, Gardner Board & Carton Co.; and W. Shannon, Macon Kraft Co.

ls. They were Dana Westcott, paper mill superintendent, st Virginia Pulp and Paper Co., Mechanicville, N. Y.; "Pat" Shannon, paper mill superintendent, Macon Kraft , Macon, Ga.; and Harry Hadley, mill manager, Gardner rd and Carton Co., Middletown, Ohio.



1. Woodside, R. P. Dustrude and Wayne Davis of the Albany Felt Co.

R. Parker, executive vice-president of Albany Felt an-ced two promotions at the company's recent technical meeting. Ray P. Dustrude has been promoted to as-nt sales manager, and L. M. Woodside has been named chief engineer of the Technical Field Service. Mr. Dustrude, along with James E. Smith, will assist Wayne Davis, assistant vice-president in charge of sales.

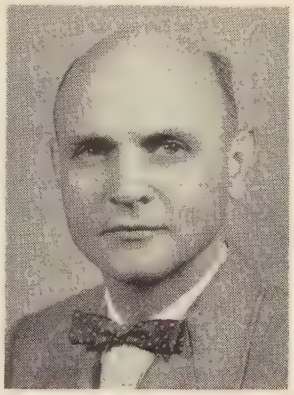
Givaudan-Delawanna

R. E. Horsey, vice-president in charge of sales announced that Thomas J. Herman has joined the sales staff of Givaudan-Delawanna, Inc., New York, N. Y., and its associate companies, Givaudan Flavors, Inc., and Sindar Corp. The new member of the Givaudan sales department will service accounts in the territory covered by the Cincinnati branch office.

Lockport Felt

W. W. Campbell, Jr., vice-president in charge of sales for the Lockport Felt Co., Newfane, N. Y., announces the addition of E. Paul Easton to their southern sales staff, effective Jan. 1, 1954.

E. P. Easton, Lockport Felt Co.



R. S. Buckley, Lockport Felt Co.

Lockport also recently announced the appointment of Richard S. Buckley to their field service engineering staff.

Welding Exposition

The American Welding Society will stage its second Welding & Allied Industry Exposition at the Memorial Auditorium, Buffalo, N. Y., May 5–7, it was announced recently by Joseph G. Magrath, national secretary. The society's National Spring Technical Meeting will be held at the Hotel Statler in the same city, May 4–7.

The society's first show, held in Houston, Tex., last year, attracted key executives from more than 20 industrial fields. The Buffalo exhibit will be almost twice as large and the attendence is expected to be more than three times as great. More than 100 exhibitors are expected and the products of more than 300 companies will be shown. Eighty per cent of the exhibit space already has been assigned prior to public announcement of the show.

Every type of welding equipment and most accessories will be on display. Exhibits will include equipment for manufacturing and structural purposes, as well as for maintenance needs. Considerable emphasis will be placed on welding techniques for the newer metals. Many automatic welding processes also will be featured.

Basic Materials Exposition

A group of 14 leading industrialists will serve as a board of sponsors for the second Basic Materials Exposition, the product development show, which will be held at the International Amphitheatre, Chicago, May 17–20, it was announced by Clapp & Poliak, Inc., New York, producers of the event. Don G. Mitchell, chairman of the board, Sylvania Electric Products, Inc., New York, is chairman of the sponsoring board.

The show, devoted to the materials used in the manufacture of products, will be more than double the size of the first exposition held in New York last June. More than 25,000 basic materials are currently available to manufacturers. Exhibits are planned to assist them in making their choices.

Concurrently with the show, a three-day conference will take place in which project engineers, product designers, materials engineers, production experts, research men and sales and marketing executives will participate.

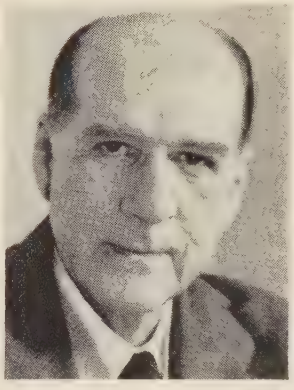
OBITUARIES

Emil Heuser

Emil Heuser, research associate emeritus of The Institute of Paper Chemistry and internationally known for his work in the field of cellulose chemistry, died December 24 at his home in La Jolla, Calif. He was 71 years old.

Dr. Heuser was born Sept. 15, 1882, in Stralsund, Germany. In his youth he had close contact with a mill which converted paper into playing cards and of which his father was technical and commercial director. This environment provided for his later interest in the manufacture of pulp and paper and in the mysteries of cellulose.

He started his advanced education at the Technical University of Munich and continued his studies at the Technical University at Karlsruhe in Baden, under the direction of Le Blanc, Haber, Bunde, and Engler, eventually specializing in organic chemistry under Roland Scholl. When the latter moved to the University at Graz in Styria, Austria, young Heuser went with him and took up his doctor's thesis work on the synthesis of oxalomalonic acid esters. After about two and a half years at Graz, he returned to Karlsruhe in 1909 to obtain his doctor's degree.



Emil Heuser

During his years at the universities, his interest in the pulp and paper field had steadily grown. His career in this field had its beginning in a mill using rag stock in Pfullingen, Württemberg. His next position was as a mill chemist with the pulp and paper mill of Altdamm in Pomerania, and one of the oldest sulphate mills. Later he moved to the Zehlendorf paper mill, a large producer of photographic paper near Berlin, where he was given charge of the coating operations. These were also one of his main responsibilities in his next position, chief chemist of the pulp and paper company of Steyrermühl, Austria.

Meanwhile Heuser had become interested in the activities of the Technical Association of the German Pulp and Paper Chemists and Engineers, had presented some papers at their meetings, and had published various articles on topics related to the industry.

When he was 29 years old he accepted a professorship at the Technical University at Darmstadt. His lectures there covered (1) organic chemistry with special emphasis on the sugars, (2) cellulose chemistry, and (3) chemical technology of pulp and paper technology. In addition he supervised laboratory courses in the chemistry of wood and conducted a special course in the dyeing of paper and textiles. Furthermore, he directed the researches of students who were working on advanced degrees.

After service with the German Red Cross for about one and a half years in World War I, he was called to Berlin to become a member of a government organization for the production of cattle fodder and industrial alcohol from cellulose material. A pilot plant, erected at Mannheim on the Rhine at the end of 1916, soon developed into a large plant with Heuser as its chief chemist. Possibly this was the first successful attempt to produce furfural on a commercial scale.

After the armistice in 1918, Heuser returned to Darmstadt. In 1921 his Lehrbuch der Cellulosechemie appeared. Within two years a second edition was called for, and by 1924 both English and Russian translations had been published.

The tremendous upswing which research on cellulose and related substances experienced in the early twenties justified the publication of a special periodical. This was founded by Heuser in 1920 under the title of *Cellulosechemie*, first as an addition to the trade journal *Der Papierfabrikant* and later as an independent periodical. Heuser was its editor until 1926.

From 1920 to 1926, Heuser was also editor of the technical section of *Der Papierfabrikant*. From 1918 to 1926 he served as secretary of the German Technical Association of Pulp and Paper Chemists and Engineers. When he left Germany he became an honorary member of that association.

In 1923 Heuser left Darmstadt to become research director at the Institute of the Vereinigte Glanzstoff Akt.-Ges., a large rayon concern in Seehof near Berlin. At the same time he lectured in cellulose chemistry and directed the laboratory work of graduate students at the Technical University of Berlin in Charlottenburg, at which he had been made an honorary professor.

Heuser left Germany in 1926 to establish and direct a research department for the Canadian International Paper Co. in Hawkesbury, Ont. Here the main objective of the researches was to develop purified pulps for rayon and other conversion purposes.

He had never quenched his thirst for academic activity and in 1938 he resumed his role as teacher when he joined The Institute of Paper Chemistry at Appleton, Wis., as a research associate and group leader in charge of cellulose chemistry. Here he was able to share in educating graduate students for positions in the pulp and paper industry, to continue his study of fundamental cellulose problems, and to cooperate with colleagues on certain industrial problems. In this favorable atmosphere and with the assistance of the Institute's excellent library, Heuser wrote "The Chemistry of Cellulose," which was published in 1944.

Unfortunately in the midst of much planning for future research work, Heuser was obliged, for reasons of health, to retire from an active program. In 1947 he was named research associate emeritus at the Institute and thereafter made his home in Southern California.

After his retirement he continued to receive recognition for a distinguished career. In 1948 he was the recipient of the TAPPI medal for his many contributions to the industry. Last year on his 70th birthday he was eulogized by an entire issue of *Das Papier*, the publication of the German Association of Pulp and Paper Chemists and Engineers. At the same time he was given the association's highest award, the Alexander Mitscherlich Denkmünze, a commemorative medal.

Even after his retirement his activities in behalf of the pulp and paper industry never ceased. Frequently he served as a special lecturer or consultant for various companies. As late as September this year he shared with Dr. L. E. Wise, research associate in wood chemistry at The Institute of Paper Chemistry, the responsibility of conducting the Annual

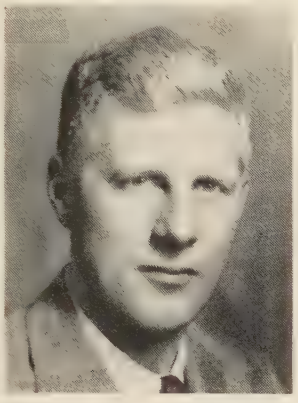
Seminar arranged by the Pacific Section of TAPPI at Seattle, Wash., and Portland, Ore.

During his lifetime he was the author of or contributor to thirteen books, editor of two journals, and author of 127 published papers.

Palmer J. Lathrop

Palmer J. Lathrop, president of the Cameron Machine Co., Brooklyn, N. Y., drowned on Saturday, December 26, in an attempt to rescue his dog. The dog had broken through thin ice on the Commonwealth Water Co.'s reservoir, Millburn, N. J. Efforts by the Millburn Fire Dept. to save Mr. Lathrop were futile.

Mr. Lathrop had served as president of Cameron since July, 1949, when he succeeded the late Harold Kinsey. Prior to his association with Cameron, he had been vice president in charge of production for the Bristol-Myers Co., Hillside, N. J. He also had been factory manager for the Rubberset Co., Newark, N. J.



Palmer J. Lathrop

He served in the Air Corps during the War as a member of the Alaskan Division, Air Transport Command. He was released from active duty in 1945 with the rank of major.

Mr. Lathrop was born in Scranton, Pa. and at the time of his death, lived in Summit, N. J. He attended Brooklyn Polytechnic School and the Hotchkiss School in Lakeville, Conn. He graduated from Princeton University in 1931 with a bachelor of arts degree.

He was active in local community work, serving as a member of the board of health in Summit. He was also a member of the Board of the Packaging Machinery Manufacturers Institute. He belonged to the Society for the Advancement of Management; the Cap and Gown Club and the Triangle Club of Princeton.

Mr. Lathrop is survived by his wife, the former Caroline Kinsey, and one son.

Jacob Schapiro, chairman of the Board who had been associated with the company for over 40 years, will for the time being assume the duties of president.

George C. Ehemann, Jr.

George C. Ehemann, Jr., plant engineer for the Ohio Boxboard Co., Rittman, Ohio, died of a heart attack on Dec. 23, 1953.

Mr. Ehemann was born in Memphis, Tenn., on Aug. 23 1910, and graduated as a mechanical engineer from the Carnegie Institute of Technology in 1932.

From 1933 to 1946 he was employed as an engineer by the Carnegie Illinois Steel Corp., Duquesne, Pa. In 1946 he joined the engineering staff of the Ohio Boxboard Co.

Mr. Ehemann became a member of the Technical Association of the Pulp and Paper Industry in 1947 and has taken an active part in the work of the TAPPI Engineering Research and Machine Design Committee and the Paper Making (Cylinder) Committee.

George C. Ehemann, Jr.

RECENT BOOKS

Handbook of Probability and Statistics With Tables. By Richard Stevens Burington and Donald Curtis May. Handbook Publishers, Inc., Sandusky, Ohio, 1953, Cloth, $5\frac{1}{2} \times 8$, 332 pages. $4.50.

The rapidly growing interest in the paper and container industries in the use of statistical methods of quality control has demanded special attention by the Technical Association.

Because of the complexity of the theoretical aspects of the subject it has been necessary for the Association to devote much effort to instructions which have taken form in intensive seminars held at regional universities such as the University of Maine and Western Michigan College. The effort of lectures and instructors during these courses and at meetings of the Association has been devoted to simplification of the subject and to demonstrations of practical industrial applications, especially relating to the paper and packaging industries.

The "Handbook of Probability and Statistics" is a welcome addition to the literature. A handbook is usually a symbol of the establishment of stability in the field that it serves. The literature of any technical field grows to large proportions and becomes a burden for the student to digest. Then, when it is propitious to do so someone issues a handbook which separates the wheat from the chaff and provides a useful tool for the worker in the field.

The Handbook is a convenient summary of theory, working rules, and tabular material useful in practical problems in probability and statistics. Readers without detailed statistical training will find this volume a sufficient guide for the more commonly met statistical aspects of their studies. Those with statistical training will find it a convenient summary of material most often needed.

The book is divided into two main parts. The first part includes a summary of the most important formulas and definitions of elementary statistics and probability theory. The second part consists of tables of distributions and other quantities of frequent use in statistical work.

Fiber Microscopy. By A. N. J. Heyn, Professor of Natural and Synthetic Fibers, School of Textiles, Clemson College. Interscience Publishers, New York, 1954. Cloth, 5×7, 421 pages. $5.50.

"Fiber Microscopy" has been prepared as a textbook and laboratory manual for textile workers. However, the papermaker who is experienced in the use of the microscope will find the volume of considerable value in developing techniques and in broadening his knowledge of such fibers as cotton, flax, hemp, jute, ramie, etc. A brief chapter is devoted to hard fibers used in papermaking and a short bibliography. Considerable attention is given to the various types of microscopes and to the new synthetic fibers.

Note: Books reviewed in this section may, unless otherwise noted, be obtained from the Book Department, Technical Association of the Pulp & Paper Industry, 155 E. 44th St., New York 17, N. Y.

REPORTS AND DISCUSSIONS

Presented at the National and Regional Conferences

Panel Discussion on Drying and Ventilating

Eighth Engineering Conference, Tuesday, Oct. 27, 1953

C. A. Young, Riegel Paper Corp., chairman: Welcome to the drying and ventilating discussion meeting. This is your meeting and we are going to throw it open to questions and answers. We have a panel here but there are quite a few of the members whom we had counted on who couldn't be here. I'd like to introduce these men to you: Starting from my extreme left is Mr. Jordan, who is chairman of the Drying and Ventilating Committee, Technical Section, Canadian Pulp and Paper Association. Next is Mr. Garrett from Canadian International Paper Co. He's well known as a drying and ventilating engineer. Next to Mr. Garrett is James McAlear, Mason-Neilan Regulator Co., whom you heard this morning give his paper on "A New Moisture Drying Control System." Next, we have Bob Cook, who is vice-president of Midwest-Fulton Machine Co. and secretary of the TAPPI Drying and Ventilating Committee. And on my left is Monty Montgomery of the J. O. Ross Engineering Corp., who delivered his excellent paper this morning.

Gentlemen, I'm going to ask you to please make this a real lively session. There's no reason to hold back. These men will try to answer your questions, if possible. You may want to direct your question directly to Mr. Montgomery relative to the discussion he had this morning, or to Jim McAlear, or to any of the other men here. Now, that is the way we're going to run this meeting and I hope we don't have too many pauses. If the meeting drags, we'll call a halt after 30 minutes; if it's still lively, we'll continue for an hour. We'll let you decide when the meeting terminates.

Robert Kinsey, Gardiner Paper Mills, Gardiner, Me.: The question that came to my mind this morning, particularly during Mr. McAlear's discussion, although it's also up Mr. Montgomery's alley, is on the economics of the moisture regulating system, particularly in view of the fact that to regulate we must vary steam pressure up and down from a set point. Let us assume, for a moment, that the maximum steam pressure available would be 50 lb. in our driers. How much below that 50 lb. would we have to set for, for our normal operating conditions, in order for the instrument to correct our conditions and still stay within the limits of the 50-lb. pressure on the driers? Along with that, how much less paper would we be making at that reduced pressure, let us say, from the higher pressure of which we would ordinarily operate? Have I made my question clear?

Mr. McAlear: Well, of course, if you're operating at maximum drying conditions, the only thing that a moisture system can do for you is to trim on one side. In other words, if you are drying at 50 lb. pressure and obtaining a given tonnage, if there are changes on the wet end or other varying conditions, which, for that steam load that you're delivering, would overdry the paper, then the moisture control system would react to set the pressure down to some value below 50 lb. Just what that is, I couldn't tell you; it's combined entirely with basis weight changes and all sorts of changes that take place on the machine.

Mr. Kinsey: What has experience shown? From some of your studies how much lower is it necessary to set pressure? Of course, I'm not asking for any divulgence of information which you shouldn't give.

Mr. McAlear: We have a board machine in New York State, operating with this moisture control system, where the safety valves were set at 60 lb. and the machine speed and total tonnage of the machine were regulated so that we dried at or about 58 lb., which meant that we were riding right up to maximum condition without actually causing the safety valves to blow. Now, I have a recording of such a chart here that indicates that we reset the drier pressure down to... 55 lb. seems to be the low point.

Chairman: Mr. O'Donoghue, I have your question here. It's a lulu. The question is "What is the effect of moisture in felts and the arrangement of the same in the variation in the drying rate through the drier section?" That's your question, isn't it? It's an age-old question. Monty, would you care to say something about that?

Mr. Montgomery: Most certainly the moisture in the felts has a good deal to do with the drying rate at any point. If the felt is too wet, it indicates that the moisture isn't able to leave the felt as fast as it's going into the felt. The function of drier felts hasn't been studied as much as it should be. I think that the greatest work remaining to be done in the drying of paper on the paper machine has to do with the function of the drier felts and getting the most out of them. On a machine with drier felts, more than 50%, I think, if the water goes into the felt in some way or other and is removed from the felt in some way or other. It's too long a story, though—that would have to be a talk in itself—but, if a felt is too wet, it indicates that the water isn't able to get out of the felt and it needs other help in the way of felt driers on air. Likewise, I suspect that a felt can possibly be too dry, in certain positions, to absorb readily. At the wet end the only way that the water can leave the paper into the felt is by absorption into the felt. It isn't hot enough to cause condensation into the felt, whereas at the dry end we have an entirely different situation where a cold felt can cause the trouble, I think. The only way we get the final percentages of water out of the paper is to get the paper heated up to a temperature well above 212°. If the felt is cooler than the temperature that we want to get the paper to, perhaps it's up to around 230 or 240°, then what we have to do is to heat up the felt through the paper, and I sort of suspect that this condition is at the dry end of the paper machine. Following that reasoning, the Feeney arrangement of driers might be especially applicable. Well, I've made too long an answer, but if there's some other phase you want answered, Rod, you tell me more specifically.

R. O'Donoghue, Consulting Enginger: Just that you might touch, Monty, on the difference between the different types of felt driers, like the Feeney type and the others, and their effect on this problem in general. You know what I mean?

Mr. Montgomery: I think we have to consider just what we're after and you can't make a generalization that applies to every machine in every case. That's what I tried to say. Now, the felt at the wet end of the paper machine is picking up moisture by capillary attraction to quite an extent, I suspect. As we go along, we reach a point where water is leaving the sheet in other ways. We have evaporation, vapor forming underneath the felt. Now, that can either go through the felt or, if the felt is below the dew point, it can

ndense in the felt. Then the water that condenses in the lt can leave it, if the felt is warm, into the air above the per machine. We've learned, especially in the last few ars, the importance of having favorable air conditions ound the felt and the detriment that can come from having favorable conditions, especially if the paper machine hood lds the highly saturated vapor totally around the top felt. e know that we aren't going to have as good drying as if the od were higher and the felt were in drier air. About the e of Feeney versus regular felt driers, well, one might conivably have so many felt driers on return, beyond the point diminishing returns, because the felt is already so dry from rt of them, that the additional ones aren't doing much od. At certain positions, as I say, I think the Feeney arngement is most excellent.

CHAIRMAN: The Drying and Ventilating Committee recnizes the big problem of the function of the drier felt and ys and means of measuring tension and moisture content the drier felt. We'd like very much to make a special bject of it and put some real work into it. We'd like to ve the felt manufacturers become interested in the probm. They have been interested and have done a great deal work on wet felts. There's been a lot published, but not drier felts. Now, the Superintendents' Association is ing work on drier felts. I don't want to put anyone in the dience on the spot, but I know there's a man in the auence who has made a special study of it. How about Mr. nett? Would you care to comment?

L. G. JANETT, J. O. Ross Engineering Corp.: Well, the ng that the superintendents have been interested in is get some data that will be reflected in the quality of felts l, to that end, there are two things that they are particuly interested in doing on the paper machine. One is that inding out what the tension is in felts and the questionnaire y sent out has indicated that out of about 66 replies, there e some 30 to 40, I would say, that indicated that the superendents did not know what their felt loadings averaged on ir machines. There was no attempt made to control the sion to a certain point. It was found in Canada, where a ilar study was made that the newsprint machines had tenns of around 4 lb. per in. of width—that was an average—reas the machine builders design machinery for working sions up to 16 to 20 lb. per in. It's been proved that the her the tension you carry, the better the felt functions in proving the drying rate but, on the other hand, it also uces the felt life. The second thing that they are interd in is to determine the moisture content in the felt, and instrument people are trying to devise means of measuring However, I believe that the TAPPI committee could do he laboratory work, off the paper machine, on finding out t the characteristics of felts are by measuring, for example, stretch as compared with the equilibrium humidity conditis surrounding the felt by putting it in an enclosure. The need, in my opinion, a new concept in drier felts construc, is to make them more open for penetration of vapor. t is a very difficult problem from the manufacturers' ndpoint—to get good life out of an open drier felt that is very stiff and which has the ability to resist wear.

HAIRMAN: Thank you, Les. Well, let's leave drier felts a minute. We'll come back if anyone has further questis on it. We have a question here addressed to Mr. Mcur from Mr. Molsberry of the Consolidated Water Power Paper Co. "Please discuss further the reason for, or the nificance of, the two reducing valves in series."

R. MCALEAR: Well, we use the first reducing station, pressure controller, and its associated valve for maintaina fixed pressure ahead of the second control valve feeding pilot drier. The primary function of this is to eliminate upstream disturbances from the steam source. For exle, if you are utilizing steam at 60 lb. and didn't make use he first primary reducing station and this pressure, due to load changes in the plant, was permitted to move to 65 lb., then the second valve, which is measuring and responding to the pressure of the pilot drier, would be repositioned and it wouldn't be repositioned because of any new condensing rate or any new moisture change that took place in the sheet itself.

CHAIRMAN: Jim, we have another question here addressed to you. "What type valve is used ahead of the control drier, and why?"

MR. MCALEAR: We use our standard diaphragm control valve which has a range of 50 to 1 and utilizes what we call a percentage V port valve plug. A valve plug for this use must have desirable characteristics; for example, you couldn't use successfully a flat disk plug because the amount of movement for the small change in condensing rate would be extremely small. The flow curve on the valve plug, for example, at 50% lift only passes approximately 15% of the valve capacity.

CHAIRMAN: I have another one here for you, Jim. "On a board machine having many driers, that is, with a long time lag, if the control system operates only on the last section of the driers, what provision is made for handling the condensate and blow through from this section?" Maybe Bob Cook can help you on that.

MR. MCALEAR: I think Bob can help me a great deal. Of course, this gentleman is doing the thing that we don't like to see done on a paper machine. We like to see two or more moisture systems on a paper machine. I would think that the logical thing to do would be to establish, through differential instruments and valves, a means of discharging the surplus steam during upset conditions or break conditions to a lower pressure source, but I'm quite sure Bob Cook has something to say on this, because it's so closely associated with drainage.

MR. COOK: Well, actually, Jim, you've answered it. In other words, to give you control of the moisture control system both at a higher or lower pressure, the differentials must be maintained across the drier for drainage and, regardless of what the moisture control system calls for, it will have to go to a lower pressure source to insure good working.

MR. A. P. ARLOV, Pulp & Paper Research Institute of Canada: Mr. Montgomery, did I understand you rightly that the samples were taken at a distance of about 8 in. from the edge of the web?

MR. MONTGOMERY: That's correct.

MR. ARLOV: Well, do you regard that as enough?

MR. MONTGOMERY: No.

MR. ARLOV: Do you have any information about the moisture distribution across the web?

MR. MONTGOMERY: Not in this study.

MR. ARLOV: I would like to ask a further question in that connection. Do you feel that some of the results that you have presented to us this morning might be in error due to the fact that you might have overdried your paper at the time of testing, or you might have had a dry edge which, in some cases, was not typical of the entire width of the sheet?

MR. MONTGOMERY: It's true the samples were not necessarily typical of the entire width of the sheet. On the other hand, what we were interested in was the variation in drying rate through the section and I think that the variation in drying rate would have followed a similar trend had the samples been taken in the center or toward the back edge, or at any other point. I can't conceive that the slope of the curve at the wet end or the middle or the dry end would have been materially different at any other point.

MR. ARLOV: I have the feeling that some of the results that you might have presented might be a little in error; in other words, we all don't waste 20% of our drier capacity as might have been inferred from your comments.

MR. MONTGOMERY: I didn't mean to infer that everyone did and, furthermore, I would like to make this clear as the result of a conversation I had after the meeting. A man criti-

cized me for inferring that everybody was wrong if he dried his paper down to 2% moisture. He pointed out that that's what his customers demand and he had to dry it to 2% or he couldn't sell it. So I tried to make clear that I didn't mean to infer that anyone who dried drier than 5% wasn't doing his job. I'm sorry if I did, because paper sold by the pound, and in some cases will only satisfy the customer if it's dried down to 2% so he isn't paying for the extra water, or at least, he thinks he isn't.

CHAIRMAN: I think that if a paper mill is drying down to 2%, it ought to charge that particular customer something extra. Our results show that due to this factor a good part of the paper machine is not doing 100%. What I mean by that is the customer very likely could change his specifications and, if he did that, we would find that we could dry and therefore process considerably more paper.

MR. BANFILL, Howard Smith Paper Mills: The question I wanted to ask was—in that first 80 or 90% of the drier section where your evaporation rate was constant, were you able to fix a constant evaporation factor per square foot of drier section corresponding to a definite steam pressure? For instance, it comes up in the problem of drier design as to the actual pounds of water per square foot of drier area that you can evaporate per hour and that is also tied in with the actual area on the drier that you are using. I was wondering if you might care to make any comments or had any data on the actual amounts of water per square foot of drier area that you were able to handle. It looked very much to me as if there should be a factor of, say, about 1.2 lb. of water per sq. ft. per hr. at, say, 10 lb. pressure, regardless of the type of product that you were trying to dry.

MR. MONTGOMERY: When the paper is published (see the January issue of *Tappi*) there will be additional data that I couldn't very well include this morning, partly for lack of time and partly because it takes time to digest a large tabulation of figures. There will be published a tabulation of all of the tests with the drying rate, production drying rate for the machine over all the driers, and for the evaporation drying rate over all the driers. I went one step further since I had raised the question of the bad effect of over-all drying rate of overdrying. I showed what the production drying rate would be and the evaporation drying rate would be to the point in the drier nest from the wet end up to the point where the sheet was 5% moisture. I took that 5% point arbitrarily, you understand—but by doing so, we eliminated from the drying rate data that portion of the machine used after the sheet was down to 5% in order to put them all on a similar basis. Now, to answer your question, we found in most all cases an average drying rate as shown in the TAPPI drying rate reports. If you will look at the TAPPI Data Sheets, you will find there what constitutes poor, average, and good performance in drying rate for any steam pressure and any classification of paper. Now, I might just add one other thing. I was curious to see what would happen if we eliminated both ends of the machine—take off the first 20% of the driers and then the last part of the driers where we had a falling drying rate. In other words, I took just the middle section of the machine which is presumably operating at the best effectiveness, calculated the drying rate, and tabulated that against steam pressure to see if I would get a much closer coordination of drying rate and steam pressure. I was sorry to find that I didn't get nearly as close a correlation as you would think. All the drying rates were pretty much all over the lot, which all comes back, as I said this afternoon, to the fact that it isn't overdrying that is the prime cause of variation after all, serious as it may be. On the paper machine the big variation in drying rate, I think, comes from variations in the intimacy of contact or effectiveness of heat transfer contact between the drier shell and the paper, which may depend upon the condition of the drier shell, or it may depend upon, more likely, the surface of the paper and the receptivity to heat of the paper.

JOHN MUNTON, Rice Barton Corp.: Mr. Montgomery, this morning you referred to total drying surface. In setting up that figure of total drying surface, did you in any way take into account the number of felt driers that might be on a machine? I'm thinking particularly of kraft machines that have in the order of 20 to 30 either felt or so-called Feeney driers. Just how did you account for them?

MR. MONTGOMERY: In the figures that will appear on drying rate, in what we call R_p, the production drying rate and R_w, the evaporation drying rate, we did include in accordance with what is now TAPPI's standard method, the felt drier surface. All the charts give per cent of paper driers. Now, that's a little wrong as it happens that all the tests were according to the number of the drier, 1, 2, 3, 4, on up to 100 and more, and it was much easier to plot the data against percentage of total paper driers but that was only for the plotting of the data. When we talk about drying rates, we always include felt drying surface equally with paper drying surface.

ARTHUR DREW, Southland Paper Mills: Mr. Montgomery, I'd like to ask this question. Your sheet, of course, has varying moisture contents across it. Do you subscribe to the idea that the best way to get rid of these variations is to overdry your sheet and then put the moisture back in by means of a sweat drier, steam shower, or water box on the calender stack?

MR. MONTGOMERY: I think you're going to put me on the spot, Mr. Drew, in saying that bad practice is the best way. It probably is the only way to get an acceptable sheet, to overdry part of it, but I don't say it's the best way. The best way is to try to correct the difficulty with the streaks.

CHAIRMAN: I would like to refer that to Mr. Garrett. I think he's the man that knows a lot about what goes on with a sheet of paper before it enters the driers and that is a very important thing to bear in mind. I will ask Mr. Garrett if he will comment on that.

MR. GARRETT: I've listened to this discussion and, now that the point of uneven drying across the driers has come up, I am especially interested. This point of uneven drying across the drier surface has been a matter of interest to me for some time. I might say that my earlier interest in drying, or fairly early interest in drying, arose in part from the publications of TAPPI on evaporating rates on various machines. Before saying anything further about the question I would like to comment on the great amount of effort that has been put into this by the TAPPI drying committee and those who have been associated with them, sparked by Mr. Montgomery and possibly, to some extent, by our old friend, Bill McNaughton. My own experience with uneven drying across the sheet is that it exists practically everywhere on cylinder driers. It seems to be a characteristic of them. In many cases, the drier seems to be considered a machine that can't be at fault and the common attitude is to attribute the streaks to bad pressing or possibly to a faulty sheet on the wire, but most generally to the pressing. For years, a very large number of tests have shown—when I say "large number" I mean thousands, not dozens or hundreds—that driers characteristically have a specific drying pattern for any given machine. That drying pattern can be altered but not, so far as I know, completely corrected with any of the means at hand at the present time. Now, I want to make it clear that I am speaking largely from the standpoint on operation on newsprint. I have had some experience on the drying of pulp, particularly dissolving pulp, and also on 9-point board and similar things but, mainly, my observations have been on newsprint. The question of getting rid of those streaks is one that I do not think has been overcome. However, the question of drier felt tension is a very important factor in those streaks. It has been mentioned that the drier sections are ordinarily built or constructed to operate the drier felts with pressures very much higher than those in common use. It was also said, I think, that the average pressure was 4 or

5 lb.—tension, rather—as measured by weighting on the felts. Now, I don't know whether that's true or not, but I have seen many machines which were drying at 4 or 5 lb. tension on the felt and, when I say tension on the felt, I am assuming that the weight that we speak of is delivering that tension per inch of width on the felt. What the actual tension is, I am not pretending to say, but that is the only figure we have. Streaks running in machines for months and years have been very greatly reduced, by increasing tensions from 5 to 10 lb. and, in many cases, I have seen them pushed up to 16 lb. per in. with very beneficial results as far as removing the streakiness. However, there still remains a basic unevenness across the sheet, which is definitely traceable to the drier section. If these evaporation rates are tested and determined for each foot of width on the drier section across the drier face, it will be found that there is a variation in the evaporation rate in the order of 6%. It is relatively small but many times it's twice or three times that and when one is making a sheet of paper—I speak of newsprint but the same thing applies in greater or less degree on other grades—if one is making a sheet of paper with a 32-lb. basis and aiming at 8% moisture, 1% moisture is roughly 2½ lb. of water per ream of paper. In passing through the drier section, under favorable operating conditions, the evaporation of water by the drier section may vary around 60 to 65 lb. per ream and the variation of 1%, you will see, is more than the total amount of water that is left in the sheet. So it's a very sensitive control that we must have if we're going to eliminate that streakiness. The justification, I think, for a great deal of the overdrying is to get rid of those streaks and it seems that, in some cases, it may be carried too far but not generally considering our present state of knowledge of drier behavior and the behavior of drier felts and of presses. I've avoided the question of presses, which Mr. Young mentioned, because I don't think that you can lay a level sheet on the wire or press evenly until you make your drier sections dry evenly. If you do, you can't sell the paper. This has been a somewhat rambling talk and I think that unless there are further questions, I had better stop here.

CHAIRMAN: There was some hidden information in the data that were collected and that concerned the temperature of the sheet of paper going through the drier section. Some of the mills were equipped so that such information could be obtained and it was found that the temperature of the sheet didn't reach 212°F. until the sheet was quite low in moisture content and it was suggested by some of the men in the mills who worked with Mr. Sawyer that this could be the basis for a moisture control system. I wonder, Monty, if you would care to say a little more about that? I think that these men would be interested in that aspect of this work.

MR. MONTGOMERY: Well, I hadn't really thought of it as a basis for a moisture control system but I will say that it has sometimes been found useful by us. I'm thinking particularly of a board or a 9-point corrugating machine—in finding out the effect of what you might consider small changes in those things which affect drying capacity. In other words, if you have a machine running steadily with 10 lb. pressure through the driers just for sake of argument, and you make the little change that might affect the drying rate. I think the most critical way to find that would be, not by measuring the moisture content of the leaving sheet, but in taking surface temperature readings of the paper on the driers up toward the dry end to see where that critical point is where the sheet temperature suddenly jumps, whether it moves back toward the dry end or not. It's surprising how critical it is. When the set reaches a certain point, it can be going along with the temperature rising steadily, and then when it reaches 10 to 9% moisture, the temperature will jump quite suddenly to get the last moisture out. There's quite a critical point there and I think that it can be useful sometimes. It's real interesting, anyway, to see where that falls on the machine.

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JOHN FRANKEVICZ, Champion International Co.: I would like to say in that connection we had an interest in determining moisture with the Cambridge instrument meter by taking temperatures of the paper while it was running. Unfortunately, we ran into a great deal of difficulty. We found that that instrument seems to react with the speed of the paper and you can be as much as 25 to 30° off, depending on how fast your paper is going at the time you are detecting the temperature. You did mention that at uniform speeds it might be a good method of determining moisture, and we are of the opinion that that could be so if it can be corrected for speed.

MR. MONTGOMERY: I don't for a moment think that a surface pyrometer, either on the paper or on the drier, measures the absolute temperature of the sheet. I know it doesn't and I know it's affected by such variables.

CHAIRMAN: We would very much like to investigate different kinds of surface pyrometers. We thought last year we might make a start on it. We realize that our information is about as good as the instruments we use to guide us. Too often we find that people misuse a surface pyrometer for if they were to put it on a pulley driving the paper machine, they'd get almost as high a temperature as if they put it on the drier itself. So, sometimes, it can be a very sad situation and some day in the future we'll have some more answers on that subject. Are there additional questions?

Most of you gentlemen, being from the States, are not familiar with the enclosed drier hood. You may have read about it. I don't know whether some of you would be interested in it, particularly the ones from the South, but we have Mr. Jordan here from Abitibi, who has had a lot of experience with enclosed drier hoods. I wonder, if he took about 3 minutes and told you before and after conditions, maybe you gentlemen would go away with something that might be useful to you.

MR. JORDAN, Abitibi Paper Co., Ltd.: Thank you, Curt. I was actually trying to grab this microphone here a moment ago when the gentleman asked the question about adding moisture to the sheet and overdrying. Now, fortunately we had an accidental experiment on one of our machines. We shut the paper machine down, and shut off the water entering the sweat drier. This was on a newsprint machine. We started the paper machine up and didn't turn on the water to the sweat drier, and we noticed that the drier pressure had dropped. A friend of mine was there and he noticed this and told the back tender to leave the water off the machine and not bother adding any moisture with the sweat drier. Well, the steam consumption per ton of paper dropped about 900 lb. per ton. We measured moisture at the reel instantaneously with the Hart moisture meter and found that, adding no moisture in the sweat drier and reducing the drier pressure, we got a very uniform sheet moisture all across the reel. We are convinced that you can run a paper machine without a sweat drier or without adding moisture to the sheet, that is, overdrying it and adding moisture to bring it up to the expected 8%.

The second point I'd like to get in, in this discussion of felts is that; we are of the opinion that you can probably dry your paper, without the use of felts on the paper machine, or without the use of felt on some sections of the paper machines. We ran a test to determine what would happen on a paper machine if we cut the felts off on the dry end and the first test, which consisted of a 2 hr. period, was very encouraging. The steam pressure went up a bit. We dropped the drier felt off and found that we could dry paper quite adequately without the use of a felt on the dry end section.

Those are the two points, the first one is that you can dry paper uniformly on a machine without the use of the sweat drier and, secondly, I think you can dry paper without the use of as many felts on the paper machine as we now use. I just want to mention those things in case somebody may have a chance to experiment with their own paper machines in their own mills.

Now, that has nothing at all to do with closed hood installation performance, before and after. We have three closed hood installations on our machines at Iroquois Falls, and last week I took some tests on one machine. When we started off last year without the closed hoods, it was running 948 f.p.m. We have speeded it up to 1263 since the closed hood installation and we're going to go higher. We increased our production 48 tons per day and we decreased the steam per ton of paper by 775 lb. Heat recovery amounted to 50% of the steam which we put into the drier surface. The evaporation rate per hour per square foot of drier surface, before we put the hood on was 2.32 lb. water per hr. per sq. ft. and, after we put the enclosure on, it was 2.83. We increased our production 36.7%; we increased the pressure about 3 lb. Actually we put on six new driers when we speeded the machine up and put the enclosed hood on but, over and above that, if we had maintained the same evaporation rate per square foot of drier surface after as we had before, instead of putting on six additional driers without the closed hood we figure that we would have had to put on 15 additional driers. I would like to say that I think the closed hood installation is here to stay and although paper companies may be adopting it slowly I think that eventually whenever you see a paper machine put in, you will see it with a closed hood.

FLOOR: May I ask you to comment on locating the hood on a board machine as well as on a newsprint machine?

MR. MONTGOMERY: I see no reason at all why it shouldn't be equally advantageous. In fact, this is beside the point but I was saying today that Mr. Herman Cutter, when he was alive, used to say to me "Why don't you totally enclose a vertical stack drier some day?" Well, I was afraid of what the operators would say and I guess the rest of us were too because we never did anything about it. So you see, some people thought about it years ago but didn't dare do anything about it.

CHAIRMAN: Gentlemen, we've been running about a hour. If there are any more questions, we will continue with the discussion. We don't want to bore you. You all know how interesting this subject is.

GORDON CHALMERS: Mr. Jordan quoted a figure of 2.83 lb. of water per sq. ft. of total drier surface, including felt driers and not including the sweat drier. How would you say that compared with the average for most newsprint machines operating, say, at 20 lb. steam pressure? Do you have anything on that, Mr. Montgomery?

MR. MONTGOMERY: Not with me. . . .

MR. CHALMERS: Burt, do you have any . . . . ?

MR. COOK: Well, I can't recall the figures offhand, except that it seems to be a high figure.

MR. CHALMERS: Any tests that I've ever run, 2.3 was about, I think, an average for 20 lb. I was wondering . . . you don't have any figures on that, Mr. Montgomery?

MR. MONTGOMERY: I'd have to refer to the sheets. . . . I don't remember, but I am especially interested, Gordon, in the figure you gave me on the pounds of steam per pound of water evaporated. I suspect that's about a record for good practice. Would you comment on that again?

MR. CHALMERS: The figure, Mr. Jordan can correct me if I'm wrong, was about 1.31. I think those figures are as correct as we are able to determine with the facilities for running tests at the mill. The tests have run consistently between 1.3 and 1.36, and I think that is certainly better than any other machines in that area. Even with economizers, they run about 1.56 or even 1.6.

CHAIRMAN: Now if there are no more questions, I think we'll conclude this meeting.

Thank you.

Total Water in Pulp Mill Spent Liquors*

TAPPI Suggested Method T 641 sm-54

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING COMMITTEE)

THIS is a rapid and accurate method for the direct determination of total water (free and combined) based on a modification of the Karl Fischer titration for water. It is applicable to spent liquors from calcium, magnesium, ammonia, kraft, and semichemical processes. The difference between 100% and the per cent of total water gives the nonaqueous constituents.

Note: In most cases it is sufficient to determine total solids in spent liquors by drying in an oven and calculating the water "by difference." (*See* T 625 m and T 629 m.)

APPARATUS

1. *Titration Assembly.* Two accurately calibrated burets are assembled as shown in Fig. 1. The framework is made of sheet Plexiglas which in turn is fastened to the titration stand. The bottle is a standard 200-ml. wide-mouth, screw-cap glass bottle with lid fastened to the plexiglas and drilled to accommodate two buret tips, two platinum wire electrodes, and the glass stirrer. Items used for the electrometric determination of the end point are a 40-ohm variable resistance, microammeter (0 to 50 microamperes), two platinum electrodes, one dry cell, and wire connections as shown in Fig. 2.

2. *Dropping Bottle.* A small stoppered bottle with medicine dropper in the stopper is suitable for weighing the sample.

REAGENTS

A. *Pyridine*, C.P.
B. *Methanol*, C.P., absolute, acetone-free.
C. *Liquid Sulphur Dioxide* (SO_2).
D. *Iodine*, C.P., resublimed.
E. *Glacial Acetic Acid*, reagent grade.
F. *Glycerol*, C.P.

PREPARATION OF SOLUTIONS

Solution I. Mix 300 ml. of pyridine and 300 ml. of methanol and add 60 grams of SO_2. This is most easily done as follows: Pour the methanol and pyridine into a bottle or beaker and place on a pan balance. Connect a delivery tube to the SO_2 supply and extend the other end of it to the bottom of the methanol-pyridine container. Add weights on the balance until the system is balanced, then add an additional weight of 60 grams. Add SO_2 until balance is again restored. The solution is unstable immediately after being prepared but becomes stable on being stored overnight. Keep in a glass-stoppered bottle.

Solution II. Dissolve 180 grams of iodine in 1 liter of methanol. Store in a glass-stoppered bottle. Each milliliter of this solution is equivalent to approximately 0.01 gram of water. Less concentrated solutions may be used for samples containing small percentages of water.

This is a concentrated solution and is most easily made as follows: Weigh the iodine into a 250-ml. or 300-ml. tall-form breaker. Add 50 to 100 ml. of methanol to the iodine and stir vigorously for a few minutes, grinding the iodine while stirring. Decant the iodine solution into the glass storage bottle. Add another portion of methanol to the undissolved iodine and repeat this process. When the total volume (1 liter) of methanol has been added, disregard the small amount of iodine not dissolved. This iodine may be used in the next supply of iodine solution made.

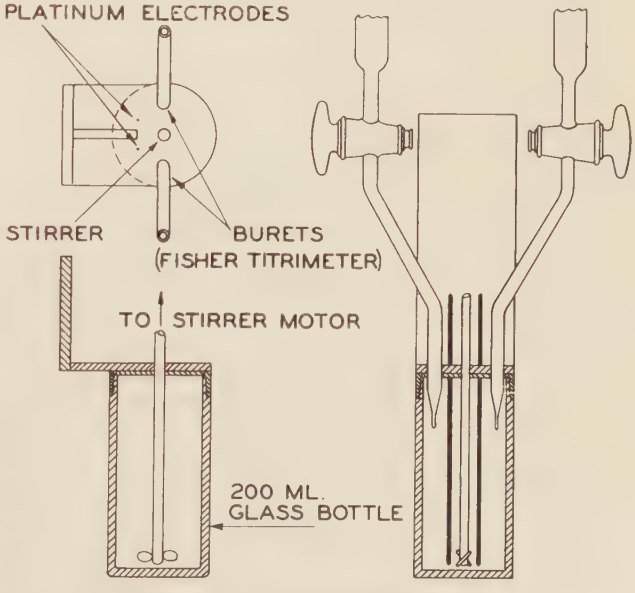

Fig. 1. Titration assembly

*This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

STANDARDIZATION

Since it is difficult to store these solutions for any length of time without small moisture pickup, it is necessary to standardize Solution II each day before starting titrations on unknown samples. To approximately 20 ml. of Solution I in the titration bottle add Solution II from a buret, 1 ml. at a time, until the end point is approached, then dropwise to the end point described below. Record the volume of Solution II used. To the solutions in the titrating bottle add an accurately weighed amount of water from a dropping bottle. (Using a Solution II of the concentration specified above, a convenient weight to use is about 0.3 gram, requiring about 30 ml. of the solution to reach the end point.) Continue the addition of Solution II until the end point is obtained. Record the volume of Solution II used in the second titration and from it calculate the water equivalent of 1 ml. of the solution.

DETECTION OF END POINT

Start the stirrer motor and adjust the variable resistance so that the potential between the platinum electrodes produces a deflection of about 10 microamperes on the microammeter. Proceed with the titration with Solution II. As the end point is approached the ammeter needle starts to swing, and at the end point maximum deflection is obtained. To insure that the end point has not been exceeded, turn off the stirrer motor. If the end point is a true one, the needle slowly drifts back to a minimum deflection and rises to maximum deflection when the stirrer motor is again started. If the end point has been exceeded, the needle remains steadily at maximum deflection when the stirrer motor is turned off.

DETERMINATION OF IODINE-CONSUMPTION CORRECTION

Since side reactions occur in some spent liquors upon titration with Solution II, a correction is necessary in such cases for the amount of iodine consumed by these side reactions.

Transfer an exactly weighed sample of liquor to a clean titration bottle and dilute with 20 ml. of absolute methanol. Stir until the liquor is completely dissolved or suspended, then adjust the microammeter needle at 10 microamperes. Titrate with Solution II until the ammeter needle shows its first rapid deflection. The volume of iodine solution used in this titration is the measure of the iodine consumption of the sample. This volume of solution II divided by the sample weight gives the iodine consumption per gram of sample. This equivalent multiplied by the weight of the sample used in an actual water titration will give the amount of Solution II which should be subtracted from the buret reading during the titration of water.

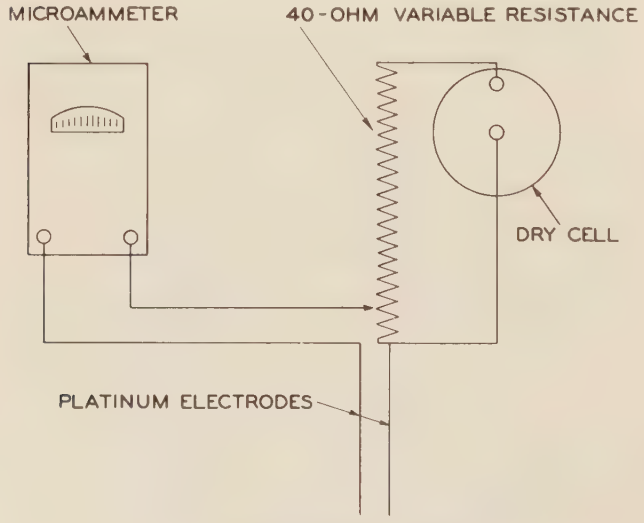

Fig. 2. Diagram for electrometric titration

TEST SPECIMEN

The amount of spent liquor sample used in the determination is dependent on the approximate water content. A sample containing 85% of water is limited to 0.45 gram and one containing 50% of water to 0.80 gram. Samples containing water in an amount exceeding 85% should weigh 0.40 gram.

PROCEDURE

Thoroughly shake the liquor sample, transfer a portion into a dropping bottle and weigh the dropping bottle and contents accurately. Add 20 ml. of Solution I to the clean, dry, 200-ml. glass bottle, titrate to the end point with Solution II and record the volume used. Transfer the appropriate portion of spent liquor from the dropping bottle to the liquid mixture in the 200-ml. glass bottle. (Reweigh the dropping bottle accurately and record the sample weight.) Continue the titration by the addition of Solution II from the buret to the electrometric end point.

Subtract from the volume of Solution II needed for the second titration any necessary iodine-consumption correction and from the difference calculate the percentage of water in the sample.

MODIFICATION FOR CONCENTRATED CALCIUM-BASE LIQUORS

If a concentrated calcium-base liquor is added to the titrating mixture, it will form a gummy mass which cannot be dissolved by the titrating mixture, and the water titration is unsatisfactory. The following modification obviates this:

Add 20 ml. of Solution I, 20 ml. of glacial acetic acid, and 20 ml. of absolute methanol to the titration bottle. Titrate to the end point and add the sample. Start the stirring motor and proceed with the titration. The sample will be completely suspended or dissolved in the presence of the acetic acid and the titration can be easily completed. The iodine-consumption corrective titration is carried out in 20 ml. of acetic acid and 40 ml. of absolute methanol.

MODIFICATION FOR CONCENTRATED SEMICHEMICAL LIQUORS

If a semichemical liquor of more than 50% solids content is added to the usual titrating mixture, the liquor will form a gummy mass similar to that formed by a concentrated calcium-base liquor and the following modification is necessary:

Dehydrate C.P. glycerol by heating in a beaker until rapid boiling occurs, and continue to boil for 10 minutes. Pour into an Erlenmeyer flask stoppered with a tinfoil covered rubber stopper and allow to cool. Add 15 ml. of this glycerol, 15 ml. of absolute methanol,

nd 25 ml. of Solution I to the titration bottle; titrate o the end point and add the sample. Start stirring imediately and stir until the sample is in solution; then roceed with the titration. The iodine-consumption orrective titration is carried out in 15 ml. of glycerol nd 40 ml. of anhydrous methanol.

ADDITIONAL INFORMATION

This method was originally proposed by the Acid ulping Committee.

REFERENCES

Phillips, J. H., *Tappi* 23, No. 10: 101A–110A (Oct., 1951).
Mitchell, J., Jr., *Anal. Chem.* 23: 1069–1075 (Aug., 1951).
Mitchell, J., Jr., Kangas, L. R., and Seaman, W., *Anal. Chem.* 22: 484–485 (March, 1950).

aper and Packaging Specifications

INTERNATIONAL STANDARDS

During the period of the World Chemical Congress held in ockholm, Sweden, a group of technologists, representing lp testing interests in several countries met on Aug. 4, 53, to discuss ways in which cooperation might bring about tandardization of testing procedures that would be acceptato all concerned.

The individuals present were:

J. J. C. Knewstubb, Australia
H. Sadler, Austria
)tto Maass, Canada
S. Wang, Canada
B. R. Nybergh, Finland
I. Sihtola, Finland
R. Bartunek, West Germany
H. Lutze, West Germany
F. Schurz, West Germany
H. Iwanow, East Germany
T. L. Raine, Great Britain
, Tachi, Japan
O. Ellefsen, Norway
F. Löschbrandt, Norway
P. O. Bethge, Sweden
G. Gran, Sweden (*secretary*)
H. W. Giertz, Sweden (*chairman*)
E. Hägglund, Sweden
. Jörgensen, Sweden
K. Wilson, Sweden
M. Rutishauser, Switzerland
). Goldschmid, United States
. F. Martin, United States

Prof. Hägglund opened the meeting and explained how it been made possible due to the initiative taken by Verein Zellstoff- und Papier-Chemiker und Ingenieure (Zellming). Invitations were sent from Zellcheming to corrending organizations in other countries.

t the request of Prof. Hägglund, Mr. Giertz took the ir during the discussion.

. Bartunek, as a representative of Zellcheming, expressed heir opinion that as the time of more or less isolated naal markets for pulp has now definitely passed and the producing and consuming industries are in closer con- it appears increasingly necessary to have methods unially recognized and used. At the moment the need for an rnationally adopted method for determination of the alkali bility of pulp is very urgent. The standpoint of Zellming in this question was written up and given to the abers of the meeting in advance.

tto Maass stated that the question of international standhad been thoroughly discussed at a meeting held July 30 to Aug. 1, 1953, in the Paper and Board Division of the Applied Chemistry Section of the International Union of Pure and Applied Chemistry. The Division of the Union did not consider it within its province to assume any sort of executive responsibility in this field but gave assurance that should there be ways in which help can be given to promote first class international testing procedures, the Division would be very willing to give as much support as possible to this end. In the minutes of the Division meeting the Division has expressed its opinion concerning the lines along which this difficult problem should be approached.

All the members of the meeting agreed that international analytical standard methods would be of great value for everybody and expressed their readiness to help in realizing this project. The alkali solubility test was considered most important for the moment and it was decided that this subject should be discussed.

Discussion About Using a Method for Determination of Alkali Solubility Instead of the Existing Alpha-Cellulose Methods

The members of the meeting received copies in advance of two methods for determination of the alkali solubility which in principle differ from the alpha-cellulose determination in that the pulp never is brought into contact with caustic of higher dissolving power than the 18% NaOH. The two methods are the gravimetric German method, Merkblatt IV/29, and the Swedish volumetric method CCA8: 53.

Some members of the meeting pointed out the difficulties which may occur particularly from the commercial point of view, if the old alpha value should be replaced by some other value. The main opinion was, however, that the alkali solubility test is superior to the alpha test for characterizing the quality of the pulp. As at present the existing different alpha methods give different results it was felt that it would be worth while to try to get an internationally accepted method for determination of alkali solubility and then later try to get it accepted also by the commercial people.

From a scientific point of view it was emphasized that it was not enough to have a method for determination of the solubility at one single caustic concentration. For completely characterizing the pulp a curve over the whole concentration range up to 18% is needed. A standard method for the determination of the alkali solubility should, therefore, be such that it could be used for any caustic concentration. Such a method could then be used both for scientific purposes (the whole curve) and for commercial purposes (one or two specified points on the curve).

In order to avoid all misunderstandings when referring to an alkali solubility value it was suggested that a fundamental method suitable for all caustic concentrations should be given one number or symbol and a special applied method for commercial purpose using a specified caustic concentration should be given another symbol.

The way of referring to the soluble or the resistant parts of the cellulose in different alkali concentrations was further discussed. One suggestion was to retain the old symbols alpha, beta, and gamma with indices to tell the concentration used, e.g., $\alpha 18$, $\alpha 10$, $\beta 10$. Another suggestion was to preserve the symbol α only for historical purposes and to use quite new symbols for the alkali soluble or alkali resistant, e.g., AS_{18}, AR_{18}, or S_{18}, R_{18}. The question then arose what to call the fraction which is precipitated by neutralization (at present named beta) and the fraction which is not precipitated by neutralization (gamma). It was considered too early to come to any definite recommendation on this question which was left for a future discussion.

Discussion About the Details in a Fundamental Method for Determination of Alkali Solubility

The method suggested by the Swedish Analytical Committee (CCA8: 53) was discussed in detail and Miss Wilson answered questions about the influence of different factors

especially the influence of pulp concentration, time of treatment, the presence of air, and the way of defibrating the sample in the caustic. R. Bartunek mentioned that he had found that if the same pulp concentration and the same time of treatment is used the gravimetric (Merkblatt IV/29) and the volumetric (CCA8: 53) methods give results which are in very good accordance.

It was recommended that the Swedish Committee publish the method CCA8: 53 as a tentative method and the members of the meeting declared that they were ready to try the method and comment on it.

Future International Cooperation

The meeting did not form any kind of formal organization but it was felt that contact should be maintained and cooperation continued. In order to realize this it was suggested to appoint a secretary and one representative from each country. It would then be possible for anyone who would like to suggest a new method for international examination to send it to the secretary who would then forward it to the country representatives, which in their turn should inform others in their country interested in the item. Those who are especially interested in a suggested method and are willing to participate in the work with it could then notify the secretary who would help to form a group working on the method in question. A secretary should be appointed by each group. At the moment there was interest in a group for working on beta- and gamma-determination as an extension of the alkali solubility method. The interested representatives for Germany, Sweden, and the United States formed a group to work on this subject (secretary Miss Wilson). A group for working on viscosity determination of cellulose was also formed by representatives for Germany, Sweden, and the United States (secretary Dr. Martin).

Otherwise each national committee was recommended to work as before except with the difference that methods should not be adopted as standard before the representatives of other countries have been informed and their comments invited.

To save the secretary from too much work such information should be sent directly to the representatives.

Miss K. Wilson was appointed as secretary.

As national representatives were appointed:

Australia: D. Piper, Secretary APPITA Testing Subcommittee c/o Australian Paper Manufacturers Ltd., Woodlands Rd., Alphington N20, Victoria.
Austria: H. Sadler, Technische Hochschule, Abteilung für Zellulosechemie, Karlsplatz 13, Wien.
Canada: S. Wang, President, Industrial Cellulose Research Ltd., Hawkesbury, Ont.
Finland: H. Sihtola, Central Laboratory, E. Hesperiank. 4, Helsinki.
West Germany: R. Bartunek, Randerath (Bezirk Aachen).
East Germany: H. Iwanow, Forschungsinstitut für die Zellstoff- und Papierindustrie, Heidenau/Sa, D.D.R.
Great Britain: L. G. S. Hebbs, Edgeworth House, Arlesey, Bedfordshire.
Japan: N. Kameyama, President of Science Council of Japan, Ueno Park, Tokyo or H. Hondal, Secretary, Science Council of Japan, Ueno Park, Tokyo
Norway: F. Löschbrandt, Papirindustriens Forsknings-institutt Sköyen.
Sweden: K. Wilson, Skoghallsverken, Skoghall.
Switzerland: M. Rutishauser, Attisholz So.
United States: W. W. Becker, Secretary ASTM Subcommittee D-23, Hercules Powder Co., Exp. Station, Wilmington, Del.

Belgium, France, Holland and Italy were not represented at the meeting. The secretary will try to get into contact with people in these countries interested in these problems, and when representatives of these countries are appointed, notification will be given to the other participants.

GUNNAR GRAN and KARIN WILSON

Stockholm and Skoghall
September, 1953

EMPLOYMENT SERVICE

POSITION OPEN

P349-54. Process Engineer. Expanding technical department of progressive Wisconsin paper mill desires a graduate chemical engineer or paper technologist for process engineering studies. Some experience in paper manufacture desirable. Unusual opportunity for advancement. Age 25–35. Reply to Gilbert Schreiber, Personnel Director, Wisconsin Paper Mills Co., Brokaw, Wis.

P350-54. Chief Chemist to take charge of laboratory and plant development for paperboard, carton, container, and pulp manufacturer. Must be able to work with Sales, Management, and Production. Advanced degree and experience desirable. Midwest location.

P351-54. Chemical Engineer or Chemist wanted for research and quality control department of progressive carton manufacturer in the South. Experience in packaging field helpful but not essential. Must be up-to-date in the field of coatings, plastics, adhesives, inks, etc., and must be able to develop new ideas. Address replies with full details.

P352-54. Top-notch Salesman to sell fourdrinier, cylinder, and washer wires in the South or East. Write fully giving record of experience.

P353-54. Sales Engineer. Under 35 for large manufacturer of pulp and paper mill machinery in the East.

P354-54. For pulp and paper mill in South. Engineer experienced in techniques for recovery of air and stream-borne effluent wastes. Will be responsible for research into methods and recommending type and design of equipment. Under supervision of Technical Director. Starting salary approximately $7000.

PRODUCT DEVELOPMENT ENGINEER

Nationally known concern needs Product Development Group Leader for development of new and improved products made of nonwoven fabrics.

Location: Central New Jersey.

Essential qualifications: B.S. in engineering of paper technology and proved accomplishments in paper products. Reply to **TAPPI, Box P355-54, 155 E. 44th St., New York 17, N. Y.**

P356-54. Chemist or Chemical Engineer. One or two years' experience in packaging or paper manufacture desirable but not essential. Some travel involved. Chicago suburban area location. Salary in line with experience and qualifications. Write Industrial Relations, Research & Technical Dept., American Can Co., Maywood, Ill.

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Note: Responses to employment service inquiries should be sent to the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Southeastern

The second meeting of the program year of the Southeastern Section was held at Fort Sumter Hotel, Charleston, S. C., on Dec. 4 and 5, 1953. About 135 members and guests were present.

Activities began with a meeting of the executive committee at 4:30 p.m. on Friday and were concluded with mill visits to General Asbestos & Rubber Co. and West Virginia Pulp & Paper Co. on Saturday morning.

Plans for the Jan. 22, 1954, meeting at Hotel Dempsey, Macon, Ga., were discussed by the executive committee. Favorable comments were reported on the first issue of the Southeastern TAPPI Bulletin. All agreed that Malcolm Pineo and Bob Flick had done an exceptionally good job in getting it out. A second issue of the Bulletin was authorized.

The regular program, following the social and dinner hour, began at 8:30 p.m. Charlie Rogers, vice-chairman of the section, presided in the absence of Mr. Pineo, chairman.

Mr. Rogers introduced Mr. Degnan of General Asbestos & Rubber Co., co-host with West Virginia Pulp & Paper Co. of the Charleston meeting. Mr. Degnan welcomed the group to Charleston and invited them to tour his plant on Saturday.

The first paper on the evening program was presented by D. G. Moon, consulting engineer, J. E. Sirrine Co., Greenville, S. C. Mr. Moon's 30-year connection with the paper industry has well qualified him to speak on "The Southern Wood Pulp Industry—Past, Present, and Future."

In this interesting paper, Mr. Moon reviewed "the past" from the time of rag papermaking at Williamsburg, Va., in 1714 to the opening of the St. Regis Paper Co. mill at Jacksonville, Fla., in late 1952.

It seems that Jefferson Land's mill at Marietta, Ga., was the first in the South to make groundwood pulp; that Luke, Md., had, in 1888, one of the first successful sulphite mills in the country; and that the first real attempt to make paper from southern pine in the deep South was at Pensacola in 1903 but was unsuccessful. The equipment, however, was moved to Orange, Tex., and operated as a soda mill until 1911. It was then changed to sulphate. There is some dispute as to whether the first sulphate was made here or by the Halifax Paper Co., Roanoke Rapids.

Mr. Moon pointed out that the first era of development in the South ended in 1931 when there were about 12 mills making kraft with a capacity of around 1200 tons. Smaller mills on soda, sulphite, etc., added another 500 tons capacity.

"The present" finds 57 mills in the 12 Southern states with a daily capacity of 28,000 tons. Six mills are under construction and existing mills have expansion programs under way which will bring this capacity to about 32,000 tons daily at the end of 1954.

"The future," according to Mr. Moon lies in the degree to which a sustained yield from pine can be maintained and the possibility of further use of hardwoods.

An interesting observation was that if population continues to increase at the rate of 2.7 million per year and if the use of paper products also continues to increase at the rate of 7.2 lb. per capita per year, the demand for southern pulpwood producing area would be doubled by 1970.

The importance of fire control was emphasized when it was pointed out that fires still destroy more pulpwood than is consumed by all the mills.

Further evaluation of the future was made in the light of increased wood cost, population growth, power requirement for newsprint production, new processes, higher yield, and the pulping of materials other than wood.

In conclusion, Mr. Moon stated that the South had demonstrated its ability to take advantage of its natural resources, not only in wood but in chemical, textile, and other industries. With technical educational facilities to further promote its development, the "South can become a still greater land of opportunity."

Professor Jenness, Head of the Department of Chemical Engineering and Pulp and Paper Technology at the University of Maine, introduced his talk "The Chemical Engineer and the Pulp and Paper Industry" which follows this report, by clarifying what a chemical engineer does. The tools that the engineer has to work with were listed.

Fundamental concepts:

1. Material balances
2. Heat balances
3. Ideal contact (approach to equilibrium)
4. Reaction time

...n Degnan, General Asbestos & Rubber Co.; L. C. Jen...s, University of Maine; and C. N. Rogers, Sonoco Products Co.

C. N. Rogers, Sonoco Products Co.; W. S. Cook, West Virginia Pulp & Paper Co.; D. G. Moon, J. E. Sirrine & Co.; and C. L. Smith, National Container Corp.

Table views at dinner preceding the meeting of the Southeastern Section

Unit operations:

1. Size separation and reduction
2. Classification and reduction
3. Flow of fluids
4. Filtration
5. Distillation—extraction
6. Flow of heat
7. Evaporation
8. Absorption
9. Humidification and drying

The training of chemical engineers, today, gives them this set of tools to work with. There has been a change from the system not too many years ago when chemistry plus smattering of the other engineering fields was the training for a chemical engineer. Professor Jenness was a product of this method.

These tools have application to all industries. Professor Jenness felt that although unit operations were developed for other industries, there might be more applications of combinations of them in the pulp and paper field.

Separation of turpentine
Washing of pulp
Evaporation of black liquor
Clarification of white liquor
Drainage on the fourdrinier wire
Drying of board

Each of the listed steps in the process include combinations of the chemical engineer's tools.

As the pulp and paper field is gradually changing from an art to a science, more engineering principles are required. Work in changing from calcium to ammonia-base liquors or the penetration of the entire stick for the chemigroundwood process are just a few examples.

The group's attention was called to the Pulp and Paper Foundation at the University of Maine. The following were listed as the objectives of the Foundation:

1. Interest students in the industry.
2. Provide financial assistance to students interested in pulp and paper as a career.
3. To assure a curriculum which will interest students and train them to be leaders in the field.
4. To prepare outstanding students for leadership.
5. To provide for a staff of instructors.
6. To advance research.

One of the problems of the Foundation is to interest all branches of engineering in the field of pulp and paper. Mechanical, electrical, and civil engineers are needed with specialized training.

The importance of experience is recognized by the University of Maine and for that reason lectures by men in industry are an integrated part of the curriculum. Perhaps more support is shown by this one industry in helping improve specialized training than any other.

In summing up, three points were made by Professor Jenness. As the art changes to a science of papermaking, more engineers will be required to keep the improvement going. In each step, there will be problems that are essentially combinations of the aforementioned tools. Practical experience is of course recognized, but engineers can still help with the job.

"Possible Processes for Recovery of Soda and Sulphur from Semichemical and Acid Sulphite Waste Liquors" was prepared by Gerald Haywood, West Virginia Pulp & Paper Co., Luke, Md. Presentation was by W. S. Cook, also of West Virginia Pulp & Paper from Charleston, S. C. This paper follows this report.

Mr. Cook pointed out, with the aid of slide diagrams, a number of possible recovery processes for converting smelt or green liquor to satisfactory cooking liquor:

1. Modified LeBlanc process: Pilot-plant work was carried on with ground limestone mixed with evaporated full monosulphite waste liquors and fed to a rotary furnace. It was found that the smelt contained only one half of the sulphur in the waste liquor. All the sulphur was retained in the smelt when CaO was substituted for $CaCO_3$. The process was considered not practicable because of the difficulty of recovering sulphur from solution of Na_2CO_3 and CaS.
2. Special treatment of smelt from combustion of NSSC and soda-base acid sulphite waste liquors: (a) Forest Products process: The smelt is treated with moist $NaHCO_3$. The Na_2CO_3 produced is reformed to $NaHCO_3$ by CO_2. The H_2S is burned to SO_2 for use in sulphiting a portion of the recovered soda. (b) Oxidation of smelt.
3. Oxidation of Na_2S in green liquor on surface material.
4. Treatment of green liquor with CO_2 to produce $NaHCO_3$ and H_2S.

Several other methods were discussed including treatment of green liquor with iron or copper oxides to form insoluble sulphides and caustic soda.

Passage of green liquor through ion exchange materials and procedures for regeneration were studied.

Direct sulphitation was pointed out as being the most direct way of making sulphite cooking liquor from green liquor.

Mr. Cook completed his presentation of possible recovery processes with a discussion of the passage of air into kraft, NSSC, and acid sulphite waste liquors at elevated temperatures and pressures—the Zimmerman process.

C. L. Smith

The Chemical Engineer and the Pulp and Paper Industry

L. C. Jenness

Associations the writer has had with enginering students and alumni over a period of years raise the question, "Why are the qualifications and training of chemical engineers so generally misunderstood?" This question presupposes that they are commonly misunderstood, in support of which it is pointed out that they are often referred to by such diverse terms as "paper chemists" and "glorified plumbers." The former term infers that they must confine themselves to working with glassware and the latter, probably the more correct of the two, that they are technicians who have rather vague notions as to what the plumbing should accomplish.

One reason for this divergence of opinion is well summarized in a news letter of the T. Shriver & Co., Inc. which makes reference to a recent survey published in *Chemical Engineering Progress*. The letter reads in part as follows:

"Time was when the lad who studied chemical engineering ground his way through a course in chemistry and through

L. C. Jenness, Head of the Dept. of Chemical Engineering, University of Maine, Orono, Me.

oncurrent exposure to mechanical engineering, electrical engineering, and a bit of civil engineering! Out in the cold, old world he had to start all over to familiarize himself with he real tools of his profession and the actualities of processng.

"Today the fledgling gets a better deal. He works just as ard, but he studies the basic facts of chemical engineering. fe uses the tools. He sees the practices of production where he rules are those of chemical engineering. The cold, cold orld still has to be faced, but no one can deny that the 1953 ersion of the novice chemical engineer begins to earn his lt much sooner than his father did!"

In an address to a symposium of the Industrial Council onsored by Rensselaer Polytechnic Institute last May, illiam H. Ward, a vice-president of the Du Pont Co., disussed the characteristics of the chemical industry. He diided all manufacturing industry into two broad types "meanical" and "chemical." According to Mr. Ward the chief stinction between the two types is that "In the chemical dustry, however, the materials with which we start are ansformed into wholly different or significantly modified aterials." He recognized that even this general distincon is sometimes difficult to make as indicated by the follow- quotation. "Not all manufacturing industries are clearly finable as mechanical or chemical. In paper manufacture, example, the cellulose pulp is extracted from wood by emical processes, but the chemically purified and bleached lp is formed into a web, dried, and finished by processes t are predominantly mechanical. The operation as a ole is so closely integrated that the mechanical and chemi- steps are virtually inseparable."

When we consider that the chemical engineering profesn is less than 50 years old, that industry has changed so ch from an art to a science in that period of time, and that emical engineers have been trained to enter the industry, s not surprising that this divergence of opinion exists. The jor difference in educational training of chemical engineers come about since 1930 due largely to the pioneering efs of Warren K. Lewis and Walter L. Badger. They recized that the student should no longer be subjected to rses in chemistry with concurrent exposure to other fields ngineering, but that he should study the sciences of chemy, mathematics, and physics in a program integrated as l as possible with the tools of a chemical engineer. What, n, are the tools of a chemical engineer?

THE TOOLS OF A CHEMICAL ENGINEER

is now generally agreed among engineering educators the tools of a chemical engineer consist of *four fundatal principles* and several so-called *unit operations*. It eorized that by the proper application of combinations of e principles and operations the chemical engineer should ble to understand and practice the various chemical procs, although they be as diverse as the production of sulic acid and the manufacture of paper.

he fundamental principles are:

1. Material balances, as they conform to the first law of modynamics.
2. Heat balances, in accord with the second law of thermomics.
3. The ideal contact, as a measurement of the approach to ibrium, which results in industry from the necessary compro- between perfection and production.
4. Rates of operations, both physical and chemical, which ecessary to know in order to meet the demands of produc-

large number of unit operations have been described but ollowing are considered by the author to be the most ally useful: (1) flow of fluids, (2) transfer of heat, (3) bsorption, (4) evaporation, (5) distillation, (6) extraction, ltration, (8) drying, and (9) humidification.

OPPORTUNITIES TO USE THESE TOOLS IN THE PULP AND PAPER INDUSTRY

The first two principles can obviously be applied to any piece of equipment, or combination of several pieces of equipment, that is used in the production of any type of pulp or paper. For instance, how fast should sulphur be supplied to a sulphur burner, how much air should be utilized by the

Charles Rogers, W. S. Cook, D. G. Moon, L. C. Jenness, and Robert Flick

combustion, and what should be the volume and analysis of resultant burner gas? Furthermore, how much heat is dissipated by the burner and what quantity of cooling medium is required to cool the burner gas? These are some of a myriad of questions that can be answered by applications of the first two principles.

The ideal contact, or approach to equilibrium, is also illustrated by the sulphur trioxide content of sulphur burner gas which is simultaneously governed by the rates of chemical reactions. Another illustration of rates of operations is the formation of raw sulphite acid in an absorption tower which in turn is related to the approach to equilibrium.

With regard to unit operations the former illustrations involve flow of fluids, gases, and liquids, as well as the transfer of heat. The latter involve flow of fluids and the operation of absorption.

The alkaline pulp process, including the recovery of heat and chemicals, probably utilizes even more of the principles and operations than does the sulphite process. It has sometimes been referred to as "the chemical engineer's dream" and anyone familiar with the process can recognize various applications of each of the principles and operations enumerated.

These applications of principles and unit operations are not limited to the manufacture of pulp but are found in many phases of papermaking. The supply of pulp stock to the wire involves many aspects of the flow of fluids. Although pulp stock is a non-Newtonian fluid, the principles of flow of fluids apply to its flow through pipes, the headbox, and the slice. The drainage of water from stock on wire cloth, or felts, is essentially a process of filtration whether it takes place at reduced pressure or elevated pressure. The drying of a sheet of paper is accomplished by the balance of a rate of transfer of heat with the ability of the sheet to give up its water which, in turn, is dependent upon the humidity of the drying medium and the extent to which the system is removed from equilibrium.

Time does not permit mention of all the illustrations that can be found in the production of pulp and paper. Although it is recognized that some of the operations may have been developed to a higher degree in other industries, it is believed that this industry provides opportunities for the study of a

greater number of combinations of principles and operations than does any other.

It is to be emphasized that theoretical knowledge alone, no matter how good, is seldom effective from the standpoint of the dollar material balance. Advantage must be taken of technical skills and consideration must be made of the manifold demands on the process that are imposed by production methods and by personnel relationships. It is for these reasons that we, at the University of Maine, solicit the help of people in industry to teach our students. Particularly in recent years industry has been a source of material assistance to us in prosecuting our educational program.

CONTRIBUTIONS FROM INDUSTRY TO EDUCATION AT THE UNIVERSITY OF MAINE

In addition to the donation of several pieces of equipment which have been useful for purposes of instruction and research our educational program has been actively supported in recent years by two somewhat unrelated efforts: (1) the University of Maine Pulp and Paper Foundation and (2) a program of industrial lectures.

As a result of the foresight and efforts of several alumni of the University, the Foundation, now in its fourth year, is a duly organized corporation with a board of directors and the usual officers and committees. Its membership now consists of 58 company members and 165 individual members. Funds are disbursed from the treasury of the Foundation, on proper authority, to accomplish the following objectives:

1. To interest more students in chemical engineering or chemistry and pulp and paper courses.
2. To provide financial assistance in the form of loans and scholarships for students who plan to make pulp and paper their life's work.
3. To assure a curriculum which will attract students and men from business for advanced study and train them to become leaders in the operating end of the pulp and paper industry.
4. To select outstanding students with all-around ability, who have completed 3 or 4 years of basic college training and prepare them for positions of leadership and responsibility in the industry through the 5-year management course.
5. To augment the staff in pulp and paper courses at the University of Maine with highly qualified personnel.
6. To advance fundamental and applied research for the pulp and paper and allied industries.

Of these objectives that of training manpower is emphasized. Qualified students are encouraged to take a 5-year program by the award of tuition scholarships and grants. These are not limited to chemical engineering students, but are available to all engineering students who expect to enter the pulp and paper industry. In fact, of the 17 students now in the fourth and fifth years of our 5-year program five of them are mechanical engineers, one a civil engineer, and 11 are chemical engineers. Each of them will receive the Bachelor of Science degree of their respective divisions after completing our major courses in pulp and paper technology and selected courses in economics, business administration, and statistics. Since 5 school years are required to complete these courses we feel certain that many more young men are being trained for the industry than would be possible without the aid of the Foundation. Tuition scholarships are also available to all types of engineering students, who can qualify, and who signify an intention to follow the pulp and paper industry whether or not they complete the formal courses of instruction in pulp and paper technology. For that matter forestry students are eligible to apply for scholarships and grants if they also so signify and in this case enroll for the 5-year curriculum.

This is the sixth consecutive year that speakers from industry have made possible the sponsorship of industrial lecture courses which are scheduled for regular daytime classes. These lecture courses are entitled pulp technology, paper technology, and pulp and paper mill equipment. A schedule of lectures is arranged in advance for each course for which speakers from industry devote one session of 2 hr. each week to the presentation and discussion of a particular topic. The class meets in the daytime and is supervised by a member of the University teaching staff who also conducts the other class periods. Such a procedure permits the class to benefit from the experience and up-to-date knowledge of our visiting lecturers and at the same time allow coordination of the previously described principles. The lectures are not of the so-called "popular" type to which the student simply listens because the students are examined over subject matter covered in the course. It is found, therefore, that students appreciate the many charts, flow sheets, and brochures prepared for them by our visitors and we all appreciate the effort and expense that are borne by industry for the cooperation we receive in the prosecution of this program. In fact, it is believed that the pulp and paper industry, including manufacturers of supplies and equipment for it, has contributed more in time and effort to this lecture program than any other industry has at any other school. Whether or not that is the case, we are proud and humble to be recipients of this support.

CONCLUSION

What, then, is the chemical engineer trained to do? Whereas the manufacture of pulp and paper originated as an art and is changing rapidly to an engineering science, we hope that the graduate engineer is qualified to participate in the future development and improvement of these technological changes.

To be specific, the Jenssen acid making system for preparation of calcium-base sulphite acid was developed and used with probably little direct application of the principles and operations enumerated. It is believed, however, that as is sometimes now the case, a system is to be devised for the production of ammonia-base sulphite acid, a working knowledge of the principles and operations is essential to the most economic design of the system. There are many other pulp and papermaking processes the successful operation of which has been arrived at by experience. Although experience can never be replaced it is believed that the chemical engineering approach can be most useful in the design and operation of variety of production and research units which depend upon these principles and operations.

It is hoped, therefore, that as time goes on we will have fewer of our young alumni ask the question "why is it that some of my immediate supervisors do not seem to understand what the chemical engineer is trained to do?" In any event we hope that he is trained to be a valuable member of a working team and that he recognizes his dependence upon other members of the team, whether they be other types of engineers, economists, foresters, or most of all the indispensable technicians and experienced practical men.

Possible Processes for Recovering Soda and Sulphur from Semichemical and Acid Sulphite Waste Liquors

Gerald Haywood

Increased production of unbleached and bleached NSSC pulp from hardwoods and the use of soluble bases in acid sulphite pulping to avoid pollution has focused attention on the problem of recovering chemicals from these types of waste liquors.

The most practical solution of this problem is the use of the waste liquors as the source of new soda and sulphur for a kraft mill. The limitation of this procedure is the loss of chemicals in the kraft recovery system which limits the production of

Gerald Haywood, Luke Research Laboratory, West Virginia Pulp & Paper Co., Luke, Md.

NSSC or acid sulphite pulp to about 20 to 30% of the kraft pulp production.

The processes that are discussed in this paper are based on the collection, evaporation, and combustion of the waste liquors. For existing acid sulphite and NSSC mills, this recovery equipment requires a large capital investment. It must also be noted that NSSC waste liquors do not have as high a heat potential as does kraft or acid sulphite waste liquor because only 20 to 30% of the wood is dissolved in the cooking step. The possible processes are discussed on the basis of chemical reactions only and no consideration is given to the equipment needed to perform and control the reactions. When these two types of waste liquor are burned in a smelter, a considerable portion of the sulphur is lost in the flue gases as SO_2. The resulting smelt is a mixture of Na_2S and Na_2CO_3 which when dissolved in water is called green liquor. Some possible processes for converting smelt or green liquor to satisfactory cooking liquor follow.

1. *Modified LeBlanc process:* The LeBlanc process for making soda was based on the reduction of Na_2SO_4 with carbon (coal) to Na_2S in the presence of $CaCO_3$. The equations are:

$$Na_2SO_4 + 2C = Na_2S + 2CO_2$$
$$Na_2S + CaCO_3 = CaS{\cdot}Na_2CO_3 \text{ (double salt)}$$

The double salt is obtained as a fluid smelt at 900 to 1000°C. The standard procedure in the manufacture of soda was to cool this smelt and then extract the Na_2CO_3 with cold water. The residue of insoluble CaS was quite a problem until Claus-Chance developed their process of treating the residue with CO_2 (limekiln gas) under pressure; as per equation

$$CaS + H_2CO_3 = CaCO_3 + H_2S$$

The H_2S was burned to water and elemental sulphur in a special furnace.

The Solvay soda process displaced the LeBlanc process because of lower costs.

During a pilot-plant study of the recovery of chemicals from full monosulphite waste liquors, it was reasoned that the soda and sulphur in the liquor were the equivalent of the Na_2SO_4 and C (coal) of the LeBlanc process. So $CaCO_3$ (ground limestone) was mixed with the evaporated full monosulphite waste liquors and fed to a rotary furnace. This furnace had been modified to operate on batches of waste liquor. Oil was burned in a firebox to provide heat for combustion of the liquor. A smelt was obtained which contained only one half of the sulphur in the waste liquor. By substituting CaO for the $CaCO_3$ all of the sulphur in the waste liquor was retained in the smelt. The smelt was allowed to cool and solidify and then extracted with cold water. A solution of Na_2CO_3 and an insoluble residue of CaS were obtained. Because of the difficulty of cooling and extracting the smelt and recovering sulphur from the CaS, this process was deemed not practical.

Recently it has been proposed that the smelt obtained from the combustion of NSSC or soda-base sulphite waste liquors could be dissolved in water in the same way as kraft smelt is handled. At a temperature near 100°C., the LeBlanc double salt can be converted to a solution of Na_2S and insoluble $CaCO_3$. There is thus obtained a solution of sodium sulphide substantially free of carbonate and other inorganic salts, which could be converted to sulphite by many of the sulphite liquor conversion processes that will be described later in this paper. The $CaCO_3$ which is filtered from the sulphide solution can be reburned to CaO for reuse in the cycle.

Special treatment of smelt from combustion of NSSC or soda base acid sulphite waste liquors: The smelt is a mixture of about 50% Na_2S and 50% Na_2CO_3.

(a) Forest Products process—This process is described in a paper by Billington, Chidester, and Curran, in the *Paper Trade Journal* (9/12/ 1935) pp. 44–46. The smelt is cooled, powdered, and treated with moist $NaHCO_3$ as per equation

$$Na_2S + 2NaHCO_3 = 2Na_2CO_3 + H_2S$$

The Na_2CO_3 that is formed is dissolved and purified by filtration. CO_2 gas is passed into the purified soda solution to reform $NaHCO_3$. The H_2S is burned to SO_2 for use in sulphiting a portion of the recovered soda. Due to loss of sulphur in the flue gases of the smelter, elemental sulphur would also be needed.

(b) Oxidation of smelt—Greenwalt process patent 2,642,336 (6/16/1953). The molten smelt as it drops from the furnace, is broken up, partially solidified and cooled by means of a steam jet and then cooled in a water-jacketed chamber. During this step the smelt is protected from oxidation by blanketing with nonoxidizing flue gases. The oxidation with air at 225°C. is carried on by passing the pulverized smelt through a chamber and progressively pulverizing and agitating the charge so as to expose fresh surfaces of sodium sulphide to the oxidizing action of the air. The reactions are:

$$2Na_2S + 4O + H_2O = Na_2S_2O_3 + 2NaOH$$
$$3Na_2S_2O_3 + 6NaOH = 4Na_2SO_3 + 2Na_2S + 3H_2O$$

Greenawalt believes that practically all of the conversion is accomplished by the direct oxidation of the sulphide:

$$Na_2S + 3O = Na_2SO_3$$

3. Oxidation of Na_2S in green liquor on surface material: Drewsen patent 1,659,193 (2/14/1928). Aries-Pollak patent 2,640,718 (6/16/1953).

These patents are quite similar in disclosure. The green liquor is added to a surface material, which can be the end product of the oxidizing reaction—Na_2SO_3. The Na_2CO_3 in the green liquor also functions as a surface material. The chemical reactions are

$$2Na_2S + 4O + H_2O = Na_2S_2O_3 + 2NaOH \quad \text{(I)}$$
$$3Na_2S_2O_3 + 6NaOH = 4Na_2SO_3 + Na_2S + 3H_2O \quad \text{(II)}$$

The Aries-Pollak patent claims that the sulphide formed in reaction II goes through reaction I again and is eventually all converted to sodium sulphite. These reactions require large volumes of air and are highly exothermic. Therefore, there is a tendency for the temperature go get too high with consequent formation of Na_2SO_4. The Aries patent holds the temperature below 300°F. by controlled addition of water.

4. Treatment of green liquor with CO_2 to produce sodium bicarbonate and H_2S:

Drewsen	Patent 1,605,927	(11/9/1926)
Bradley and McKeefe	1,833,313	(11/24/1931)
Hoffman	1,915,315	(6/27/1933)
Bradley and McKeefe	1,983,789	(12/11/1934)
Larsson and Jonsson	2,496,550	(2/7/1950)
Manbro	2,611,682	(9/23/1952)

The Larsson and Jonsson process has been in successful use at the Skutskar mill of Stora Kopparberg for many years. The process is as follows: green liquor resulting from the combustion of acid sulphite waste liquor is carbonated in two steps. In step one, just enough CO_2 is passed in to keep $NaHCO_3$ from precipitating. The H_2S is then removed by subjecting the partially carbonated liquor to vacuum and heat. The liquor from the vacuum step is then fully carbonated and the bicarbonate which precipitates is filtered off and sulphited with recovered SO_2 resulting from combustion of H_2S from the first carbonating step. The filtrate from the bicarbonate crystals is returned to the smelt dissolving tank. Thus an undue concentration of thiosulphate or sulphate in the acid sulphite cooking liquor can be avoided.

The reactions are:

(1) Dissolving smelt..... $Na_2S + H_2O = NaHS + NaOH$
(2) Carbonation (step 1).. $2NaOH + CO_2 = Na_2CO_3 + H_2O$
(3) Stripping H_2S..... $NaHS + NaHCO_3 = Na_2CO_3 + H_2S$
(4) Final carbonation..... $Na_2CO_3 + CO_2 = 2NaHCO_3$

The claims in the Manbro patent are concerned with details of the treatment of green liquor with CO_2 gas in the carbonation tower.

5. Treatment of green liquor with iron or copper oxides to form insoluble sulphides and caustic soda: Moore patent 2,161,141 (6/27/1939). The chemical reaction is

$$Na_2S + CuO + H_2O = CuS + 2NaOH$$

The insoluble CuO is separated from the solution of NaOH by filtration and sent to a roasting furnace where SO_2 is formed and the CaO regenerated. It has been suggested that iron oxide or zinc oxide could be substituted for CuO in the above reaction and thus have a more practical process.

6. Passage of green liquor through columns of cation exchange resins, and regeneration of the resin column with sulphurous acid:

(a) Bickel and Tretheway, "A Recovery Method for Sodium Base Sulphite Liquor" delivered at January, 1951, meeting of the Canadian Pulp and Paper Association in Montreal—Green liquor of 79% sulphidity from combustion of soda-base sulphite waste liquor is passed upward through columns of a cation resin—IRC50—in the hydrogen form. The resin adsorbs the Na^+ ions from the green liquor and the H^+ ions form H_2S which is evolved as a gas from the top of the column. The effluent from the column and the wash water can be passed back to the smelt dissolving tank. The resin is regenerated (put back in the hydrogen form) and the Na^+ ions stripped from the resin by passing a solution of sulphurous acid through the column. The effluent from the column is a mixture of sodium bisulphite and free SO_2. The H_2S that is evolved in the Na^+ ion absorption step is burned to SO_2 and used along with SO_2 from combustion of sulphur to make the sulphurous acid used in the regeneration step.

(b) Rayonier patents 2,656,244, 245, and 249 (10/20/1953)—These patents cover the treatment of green liquor from soda-base sulphite waste liquors with ion-exchange resins. The resin used is IRC50. The green liquor is passed through the resin column at 50 to 100°C. whereby the capacity of the resin to adsorb sodium ions is increased due to the reduced solubility of the CO_2 and H_2S that is released from the green liquor. The resin column can be regenerated with sulphurous acid or with gaseous SO_2. Patent 2,565,245 has claims which cover the use of carbonic acid at 2 to 50 atm. to form sodium carbonate and thus regenerate the resin. The evolved H_2S is burned to SO_2 and used to prepare sulphurous acid when it is used to regenerate the resin column. The effluent from the sodium absorption cycle contains sodium sulphate which may be passed back to the smelt dissolving tank, or discarded.

(c) Treatment of NSSC waste liquor with ion exchange resins—when NSSC waste liquor direct from the pulp washing equipment is passed through columns of carboxylic and sulphonic resins in series the sodium ions are adsorbed by the resin and a solution of free lignosulphonic acids is the effluent. The two resin columns can be regenerated by passing sulphurous acid in the reverse direction, i.e., through the sulphonic resin and then the carboxylic resin and thus obtain a solution of sodium bisulphite. It is necessary to neutralize the bisulphite with Na_2CO_3 to form NSSC cooking liquor. As a result only a portion of the soda can be recovered.

7. Direct sulphitation of green liquor: Bradley-McKeefe patent 9,893,150 (12/27/1932). When SO_2 gas is passed into green liquor at or near the boiling point, much of the sulphide can be sulphited along with the carbonate because under these conditions the H_2S is released so rapidly that it can't react with the SO_2 to form thiosulphate. This procedure is the most direct way of making sulphite cooking liquor from green liquor.

8. Zimmerman process: When air is passed into kraft, NSSC and acid sulphite waste liquors at elevated temperatures and pressures, the organic matter is completely oxidized to CO_2 and water and the inorganic matter to sodium sulphite. It is possible by a series of reactions to make sulphite cooking acid from the sodium sulphate. The reactions are:

$$Ca(HSO_3)_2 + Na_2SO_4 = 2NaHSO_3 + CaSO_4 \quad (1)$$

$$2NaHSO_3 + Ca(OH)_2 = Na_2SO_3 + CaSO_3 \quad (2)$$

In equation (1) the calcium bisulphite is made in a standard sulphite acid making system. The $CaSO_4$ is a by-product.

In equation (2) the $CaSO_3$ is used in the acid sulphite liquor making system and is converted to bisulphite by SO_2.

It is claimed that the heat and power generated by this process will make it a practical solution of the pollution problems of sulphite mills.

Empire State (Eastern District)

Ralph Kumler of the American Cyanamid Corp. addressed the Eastern District of the Empire State Section, Technical Association of the Pulp and Paper Industry, at its December 16 meeting held at Milfranks Restaurant on the Glens Falls-Lake George Rd. Mr. Kumler spoke on theories and facts about the relation of sizing, alum, heat, and moisture as well as the effects of the presence of certain chemicals other than those intentionally introduced.

Mr. Kumler discussed the work of Eckwald and Brun at the Finnish Institute of Physics, a Norwegian group of investigators headed by Samuelson and Elifson, and the work of the foundation at the University of Maine and he related their findings as far as possible to practical operating problems. Mr. Kumler was introduced by Talmage Edmans, program chairman.

Announcement was made that the March meeting will be devoted to the report of the pulp evaluation committee headed by Grant Cole of the Diamond Match Co., Plattsburg, N. Y. Other members of this committee are Clyde Davis, Finch, Pruyn Co., Glens Falls; Paul Page, Imperial Paper and Color Corp., Glens Falls; Thomas LaHaise, Imperial Division at Plattsburg; Hugh Lavery, International Paper Co., Palmer; Wallace Howell, New York & Pennsylvania Co., Willsboro; Harold Field, West Virginia Pulp & Paper Co., Mechanicville; Kenneth Fisher, A. P. W. Paper Co., Albany; and James Rogers II, J. and J. Rogers Co., AuSable Forks.

The April meeting will be devoted to the presentation of papers in the Empire State Award Contest. The chairman of the committee sponsoring the contest is Earl Johnson, Stevens & Thompson Co., Greenwich. The other members of the committee are R. B. Blakeslee, Imperial Paper & Color Corp., Glens Falls, and Ray H. Wiles, International Paper Co., Glens Falls.

Allen A. Lowe, *Publicity Chairman*

The following paper was presented at the November meeting of the Eastern District but was received too late for the January issue in which reference is made to it.

Selecting, Measuring, and Developing Men

J. Baker Middelton

When I was originally asked to supply a subject for my remarks this evening, I thought that "man-power development" was sufficiently broad to cover anything I might want to say. I found, on the other hand, in getting more deeply into the subject that there are several very important steps that must be undertaken before we can even start the process. It seems to be pretty fundamental that we can't even think, talk, or do anything about man-power development until w

J. Baker Middelton, Personnel Manager, Marinette Paper Co., Fo Edward, N. Y.

get the men to develop and until we know what kind of men we have to work with.

So I'd like to take liberties and use as a subject "selecting, measuring, and developing men."

To put my remarks in the proper perspective, I should say that most of my references will be to the way that Scott Paper Co. looks upon the selection, measurement, and development of its management men. Secondly, it might be well to remember that Scott Paper Co. is a multi-plant organization of national scope and is rapidly expanding. From total sales 20 years ago of about $7½ million to its 1952 sales of $129,000,000 has been added a goal of $300 million in 1958, a short 5 years away, so that our approach has, by necessity, been conditioned by a need for new men of considerable potential and a requirement for increased tempo in our training and development activities.

First of all, let's look at this business of selecting men—actually I think the ultimate success or failure of any enterprise largely depends upon what kind of job they do at this all-important first step. It's pretty basic that we start with good material, just as we do in the development of a piece of machinery. You who are engineers wouldn't start with steel or any other material that lacks strength or integrity and the other qualities you know ahead of time are necessary to develop what you want. You insist that it contain these qualities and in case of doubt, what do you do? You reject it of course! The same thing goes for man-power selection—let's be certain that anyone we hire possesses the basic qualities we know ahead of time are essential to success. It just doesn't make sense to put someone on the payroll who lacks integrity, intelligence, potential for growth, and so forth.

This is the time to keep your standards high, to be tough—once you've succumbed to compromise it's fatal because it becomes a habit for you can't build men who don't have what it takes to grow with the organization.

If you're having trouble getting top-notch talent, you'd better do some introspective thinking and ask yourself some embarrassing questions—maybe you'll have to take steps to provide what is needed in terms of pay, opportunity, good human relations, etc.

Once you've attracted and hired what you believe to be good men, the job of development starts—the first step is, of course, proper initial placement which I will not attempt to expand upon except to suggest that consideration be given such things as the new man's own desires and interests, the company's initial appraisal of his potential or special skills, and a decision made as to what placement will contribute most to his longer-range usefulness to the company.

The next step is to set up a qualifying period, usually 6 months, as a means of mutually "sizing one another up." (This should be considered as part and parcel of the original application and should be so understood.) Remember this works two ways—both you and the new man should use this period of time to decide whether or not the arrangement is all that it appeared to be on the hiring date.

During this period and particularly in the early stages, there should be an orientation program that's realistic and practical but of such length that in fairness to the new employee he is able to familiarize himself with his job and surroundings. As early as possible, he should be assigned to a definite task—even if of short duration—so that you can get some indication of his ability to produce results and to observe his way of doing things. Frequent talks and counseling should be set up during this period so that a mutual exchange of information can readily take place.

At the end of this qualifying period, the second and perhaps even more important decision must be made—has the new man met our high standards, is he a winner—do his strong points far outweigh any weak points—are the weak points only and of a relatively minor nature which we are sure can be overcome in a reasonable time?

This again calls for objective thinking and evaluation of the highest order—this is no time for sentiment or emotion—the seeds of human kindness and compassionate thinking are truly great things. At this point, they should not be controlling. This trial period offers the most painless and fairest opportunity to call it quits that you will ever have with this man, so take advantage of it—you are doing the man a favor and your company a real service to make the right decision at this time. If there are real doubts that the new employee is a winner, don't keep him! If you pass up this opportunity and are not completely honest and objective, it will become harder and harder to rectify your mistake later.

Alexander Heron in his book "Sharing Information with Employees," I think has put it well. He describes the obligations a company accrues to its employees in this way:

If a casual worker agrees with us to work for 8 hr., at $1.25 an hour cleaning out the storeroom, we can close the account with him at the end of 8 hr. He has given us 8 hr. of honest work as he agreed. We have given him $10 as we agreed. He owes us no more; we owe him no more. But if he comes to work on a regular job, starting at $1.25 an hour, a different story unfolds. At the first payday the stories look alike. In the week he has given us 40 hr. of honest work, as he agreed and we have given him $50 as we agreed. Perhaps, he owes us nothing more and we owe him nothing more that can be recognized at that time. But even then there is a subtle difference: when he was hired, he received from us an opportunity to qualify for a continuing job. We received from him the implied commitment to try to fit into our way of work, to learn our methods, and to remain with us and give us the benefit of his continued learning. But it takes months and years to show the real difference between this story and the story of the man who came to work for just 1 day.

Assume that the second man was 25 years old the day he came to work. He "fitted in," he learned our ways, he gained experience, he acquired new skills, and took on new responsibilities. As he did so, his rate of pay was fairly increased. As the years pass he is suddenly 40 years old—above the average age of employees in American industry. He has been our employee for 15 years. His present rate of pay is $2.00 per hour. His average rate for the 15 years has been $1.60. He has given us 30,000 hr. of honest work. We have paid him $48,000. Can we close the books with him? Can we say he has given us the agreed hours, we have paid the agreed dollars, and there is no more owing, by him or by us?

He has put into the job, into the enterprise, 15 years of his life. They are not just 15 years, either; they are the 15 years which should be the foundation of all of his later life earnings. Those years are his investment in the enterprise. We cannot give them back to him. We can pay off a bondholder, or buy out a stockholder; but we cannot buy out the investment this worker has made. We wanted him to stay with us and put in those years. We want him now, as through those years, to protect and promote the business which is his job, as if it were his own. And it is his own in a way which neither he nor we can change. He is not the same man at 40 that he was at 25; the difference has been invested in this enterprise.

True, he has gained in some ways. He has gained skills, knowledge, maturity. He may have money in the bank, an equity in his home or in a life insurance policy. On the other hand, he has lost youth, adaptability, salability. He has lost 15 years of the promise of future usefulness to any enterprise. He has risked or staked his chances of employment and income, during middle age and later years, on the future soundness and success of this enterprise. He can take away with him his acquired skills, knowledge, and reputation; he cannot withdraw the investment of the years of his youth. The important question is, has he invested those years or merely spent them?

I think that Mr. Heron has, by this simple example, emphasized the obligation that we of management have to our em-

ployees and my point here is to be sure that in view of this, we don't retain on our payrolls men about whom we have doubts for the future.

So you see that your obligation to this man is of a low order at the end of a brief qualifying period and the opportunity to terminate what has perhaps been an unsatisfactory association is yours—take advantage of it, in fairness to the man and to the company.

My reason for spending so much time on the selection of employees is based on a deep-seated belief that training and development are relatively simple when high-grade material has been made available for the trainers. In one sense, good men, even under the "sink or swim" method of training will demonstrate a pretty good batting average. I certainly don't advocate the "sink or swim" method, but mention it to emphasize my feeling that the response of high caliber men to any training method will make whatever techniques we use, more certain of success.

The next important phase of man-power development is a continuing one that must go on at all times—and I'm speaking now of the appraisal or evaluation of our people. It should be a state-of-mind, an inquisitiveness on the part of everyone who supervises others. How is he doing should be an ever present question.

If this "habit" of continuing appraisal has been developed as a normal part of the management job, it is relatively easy to formalize the process on a once-a-year basis.

In our particular company the formal appraisal process is comparatively new and consists of three basic steps:

A. Appraisal of the individual (not only current job performance but of his potential).
B. Review of the appraisal by the man's superiors.
C. Discussion of the results with the individual and the development of a plan of action in terms of training and development.

We believe that this process accomplishes at least three important things:

1. It permits, indeed requires, management to specify what it expects of the individual and to tell him how well he is fulfilling these expectations.
2. It allows the man to question the appraisal and to air his own feelings.
3. It develops a mutually satisfactory training plan.

These appraisals are sent to our home office along with specific recommendations as to a source of action—for those persons who are immediately or potentially promotable, suggestions are made as to what jobs they should be considered for and when they will be ready for promotion.

All of these appraisals are included by our staff industrial relations division in a personnel inventory which is just what the name implies—an inventory of what the company has to work with as far as people are concerned. This inventory is kept up to date and is used for formulating training programs, for career planning, and for supplying good men for vacancies as they occur.

Perhaps, I can give you a brief idea of how this works in Scott Paper Co. by reference to what I have called the personnel balance sheet.

These charts show very generally what takes place in our industrial relations division in our home office as far as the use of the inventory is concerned.

For purposes of illustration, I have shown a hypothetical phase of our business (it might be engineering, it might be production, sales, or what have you) in this case it will be called department X.

The first step is to spot all the jobs in the X department both organizationally and by level of responsibility—the vertical scale corresponds roughly to grade levels under the job evaluation system.

The first step is to obtain immediate and longer range needs from the department itself.

We see that in the case of department X, two or three trainees can be used immediately and as upper positions are filled, four more trainees will be needed. By discussion of the problem, a decision is reached as to whether or not they should be obtained now or at a later date. Possible placements for these trainees are worked out and are indicated by dotted lines.

The next step is to go to the personnel inventory and obtain information from the appraisals as to who's who in the X field.

On this chart, those who need additional training or special attention are indicated by a red X—those who are doing an outstanding job and are ready for promotion are shown by a green check. A T designates good training jobs where turnover is least damaging.

So we see that when requirement comes up, we know where the possibilities lie and it becomes a far easier task to make the necessary and desirable moves from the available information.

Before concluding my remarks, I should like to briefly cover some of the means used in our man-power development program, which is ever changing and is patterned to the needs uncovered in individual appraisals.

A. On-the-job training.
B. Job rotation.
C. Lateral moves (broadening effect).
D. Special work assignments (project assignments).
E. Attendance at meetings (production, engineering, cost meetings, labor relations meetings, etc. Special sessions such as "what're we doing," personal conference, engineer's conference, sales conference, etc.).
F. Individual counseling and coaching—primarily by superior who is expected to train his own replacement—but also by all key people who maintain "open door" policy.
G. Extracurricular training: (1) Special short-term courses at nearby universities; (2) Harvard course, Pittsburgh, Wharton School, etc., (3) educational refund policy.

In carrying out these and other aspects of our total man-power development program we share the belief with many others that:

1. It is the obligation of management to provide the opportunity and the means for the growth and advancement of those who seek and qualify for greater responsibility.
2. Training, in its broad concept, is the primary means whereby management can fulfill these obligations and responsibilities.
3. Training is an integral part of the management function and cannot be readily delegated.

And finally, we believe that:

4. The logical and psychological point at which training can best be given is between an individual and his supervisor.

In summary, I believe that sound man-power development is preceded by good selection of men and begins with their proper placement and orientation, followed by constant appraisal and the establishment of a personnel inventory so that we know what we have to work with, and by then applying good, well thought-out training techniques, so that we make the very most of the man-power we have.

In any enterprise, we are concerned with men, money, and materials—there's little doubt I'm sure in the minds of all of us which of the three is going to spell the difference between success and failure of the enterprise. People are our most important consideration—let's make the most of them.

Empire State (Northern District)

The Northern District of the Empire State Section of TAPPI had as its speaker for its December meeting Paul A. Sartoretto of the W. A. Cleary Corp., New Brunswick, N. J. Over 60 members and guests heard him describe a new slimicide, "No-Slyme." It is a heterocyclic organic compound containing nitrogen and sulphur, and is both nontoxic and

odorless. Unlike all other slimicides, it is so slightly ionic that for all practical purposes it can be considered to be nonionic. Consequently, this material is only slightly inhibited in its activity by electrolytes, lignin, cellulose, or foreign organic matter. For the first time in the history of slime control a product has been developed which stays in the mill water long enough to control slime efficiently.

This slimicide slowly hydrolyzes in cold water, more rapidly in hot water, losing partial activity. High temperatures with the product are to be avoided, since heat alone decomposes it. Mill water temperatures of 140 to 150°F. do not cause excessive decomposition.

No-Slyme forms an insoluble amine complex with organo mercurials, the resulting product is further decomposed by the sulphur to metallic mercury which will cause serious copper screen embrittlement. No-Slyme and mercury compounds should not be used together for slime control. Bacteriological tests in the laboratory show that it is as effective as mercurials or chlorinated phenols in inhibiting or killing bacteria or fungi.

It is general knowledge among control superintendents that slime control with mercurials and chlorinated phenols can only be accomplished by slug treatments of these chemicals, and not by continuous feed. Furthermore, chemical and bioassays of mill waters carried out during the course of treatment with mercurials definitely prove that an effective dosage of these chemicals persists for only a few hours out of the whole day. However, bioassay data show that No-Slyme treatments are cumulative over a 24 and sometimes 48-hr period, showing a gain in slime control as the treatment persists. Mercurials and chlorinated phenols are readily adsorbed by cellulose, lignins, etc. and are filtered out of the water rapidly. No-Slyme is not readily adsorbed and remains in the water for a longer period. Its success is due to this nonionic, nonadsorbent phenomenon. It is the only plausible explanation for the favorable results obtained in paper mill test runs.

RICHARD J. MURTAUGH, *Secretary*

Ohio

One hundred twenty members and guests attended the Dec. , 1953, meeting of the Ohio Section of TAPPI at the Amerian Legion Hall in Middletown, Ohio. Chairman John louse welcomed the group and conducted a short business eeting before proceeding to the program of the evening. he minutes of the previous meeting were read by Recording ecretary Ellsworth Shriver and approved. Treasure eorge Gregg gave a financial report and urged all members, ho have not already done so, to pay their Section dues. rogram Chairman Bill Aiken announced the January 12 eeting to be held at the American Legion Hall in Middleown, which is to be a talk on statistical quality control by E. Sooy of Sorg Paper Co. Members are urged to return eir reservations promptly to John Nolan, corresponding ecretary.

Charles Sweitzer, of Gardner Board & Carton Co., introduced the speaker of the evening C. A. Sankey, research director of the Ontario Paper Co., who spoke to the group on "Radioisotopes in the Paper Industry."

Mr. Sankey opened his remarks by stating that radioisotopes are very useful tools for the paper industry but are not all-powerful. The Ontario Paper Co. has a mill at Baie Comeau, P. Q., which has two machines making newsprint at speeds of 1700 to 1800 f.p.m. Newsprint production is in the pioneer stage in spite of the progress which has been made. The biggest problem inherent in high-speed production is variation on the paper machine consisting of eddies, whirls, and stray currents. This variation problem gets more difficult as higher speeds are attained. Any tool which will give more information on this subject can be very helpful. Radioisotopes fall in the group of tools which are very useful in studying these high-speed paper machine variations.

Following fiber around the papermill can be done by tagging certain fibers with adsorbed radioisotopes and mixing these tagged fibers with the main stock stream. Any flow

From left to right: John Clouse, Oxford Miami Paper Co., Ohio Section chairman; C. A. Sankey, research director, Ontario Paper Co.; and Charles Sweitzer, Gardner Board & Carton Co., program committee, who made the arrangements for the program

can be traced by this technique. Mr. Sankey stated that if information obtained on stock flows is useful then the radioisotope tool is useful but otherwise no. The tool is not useful in itself. The Ontario Paper Co. is constantly striving to increase the speed of its paper machines. Some work along this line is confidential. What can be discussed is the experimental method of tagging fibers worked out by the Ontario Paper Co., in conjunction with the Pulp and Paper Research Institute of Canada and some of the data obtained. (For detailed experimental data, the reader is referred to the article by Sankey, Mason, Allen, and Keating in the *Pulp and Paper Magazine of Canada* 52 No. 3: 135–146 (Convention Issue, 1951).)

The choice of radioisotope for use in tagging fibers is dependent on the following: (1) the isotope must be adsorbed; (2) must be an isotope which will not harm regular production and can be followed by established techniques; (3) the isotope must therefore have a short halflife so as not to harm personnel and yet long enough to permit shipping, handling, and experimental runs—3 to 15 days halflife is ideal because 3 to 4 days must be allowed for shipment.

Radioiodine has a halflife of 8 days and is an ideal tagging material. The isotope remaining after 2 months' time is less than 1% of the original material. Radioiodine can be analyzed accurately provided the time of original assay is known. In the experiment run at Baie Comeau, an error of $\pm 1\%$ corresponded to about 3 hr. time. Radioiodine was obtained as pure NaI^{131} in aqueous solution. One hundred millicuries of iodine-131 were secured (which corresponds to 8×10^{-9} grams of the radioelement) from the Canadian Atomic Energy development at Chalk River.

In preparing the tagged fibers, groundwood pulp which had been classified to remove fines was soaked in strong silver nitrate solution, drained, and then soaked in sodium chloride which served to chloridize the pulp. The pulp was then washed. Then 1 part per 100 million of radio sodium iodide in solution was added to the 500 grams of tagged stock used. The tagged iodine partially replaced the chlorine in the silver chloride in the fibers. The resultant radio silver iodide is

tenaciously held by the fiber. The 100 millicuries of radioiodine used were much more than is actually required. One millicurie is sufficient for spot experiments. The method of tagging fibers was illustrated by the following steps.

Step 1—removal of fines
Step 2—immersion of fibers in silver nitrate solution
Step 3—immersion in sodium chloride solution:
$Ag^+ + Cl^- \rightarrow AgCl$
Step 4—immersion in active sodium iodide solution:
$AgCl + I^{131} \rightarrow AgI^{131} + Ag^+$

At the time of the experiments, the no. 2 machine at Baie Comeau had a speed of 1728 f.p.m. and was equipped with six Bird screens at the wet end. The tagged fibers were fed into the Bird screen on the back side of the machine and then through the pond and onto the wire. The slice flow was 8200 imperial g.p.m. at a consistency of 0.6%. Two hundred sixty-six oven-dry tons per day of stock were leaving the couch and the production was 250 tons per day of newsprint from the machine. Two hundred eighty-eight tons per day of mixed stock were fed to the fan pump. The radioisotope tagged fibers were added by means of a pump controlled by a variac and attached to a calibrated tank. A total of 500 grams of tagged fibers were added to 3.7 tons of stock.

Radiotracers added must be blended in order to get good sampling. A slide of a radioautograph prepared from a sample of paper containing tagged fibers was shown to the audience. Approximately 25 to 50 active areas per sq. in. were found on the "hot" side of the reel. The accuracy of a radioanalysis depends on the total number of counts made in the analysis. A count of 3000 on each sample along with the distribution of active areas was found to give a calculated standard deviation of 2.5%. One of the interesting aspects of any radiotagging experiment is that the experimental error can be determined in advance.

From left to right: Ohio Section chairman John Clouse of Oxford Miami; program committee chairman Bill Aiken, of Gardner; Chuck Sweitzer, program committee member, of Gardner

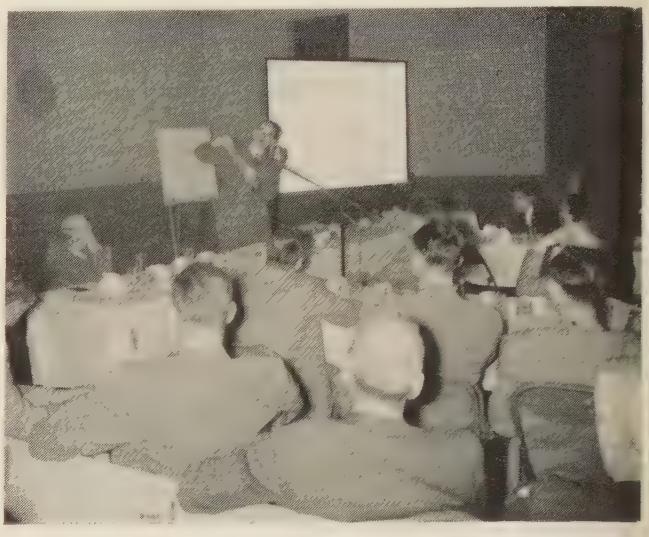
The method of qualitative analysis used required a portable counting-rate meter (Tracerlab Laboratory Monitor, Model SU-3A) with an attached beta-ray counting Geiger tube. Quantitative counting was done on standard 3-in. samples using a fixed Victoreen 1B85 aluminum wall (30 mg./sq. cm.) cylindrical Geiger tube designed for counting beta particles mounted in a lead casket. The same counter must be used in all phases of a radiotiotope experiment because of the pronounced effect of geometry on the count. Basis weight variations were compensated in the counting procedure.

The results of the experiment indicated that there is considerable mixing of the stock from the Bird screens across the machine and it was found that radioactivity appeared on the "hot" side of the reel, 1 min. after addition at the Bird screen and 30 sec. later appeared on the "cold" side of the reel. After 5 min. equilibrium was established. The addition of tagged fibers was completed in about 10 min.

A curve of time versus activity at a sampling station across the web showed a gradual build-up to a mean level with violent fluctuations about this level followed by a decay curve after the addition of tagged fiber was discontinued. One of the most interesting results of the experiment was the discovery that about 7% of the stock from the back side Bird screen got all the way across the sheet to the front side of the web. The center lines of the six Bird screens were easily detected in the analysis.

Analysis was made of variation in activity in adjacent areas of paper. The standard deviations found, varied from 4.9 to 9.7% which was therefore significant over the sampling and counting errors. The variation in the machine direction found establishes the existence of headbox eddies and stray currents which affect paper uniformity.

Mr. Sankey then made a few remarks about the beta thickness gage (bench model) which is another example of the use of radioisotopes in the paper industry. The beta gage gives a basis weight profile which agrees with weighed profile only if approximately 20 beta gage profiles are averaged. Any given beta gage profile does not compare too well with the weighed profile because of small sample areas.



C. A. Sankey, research director, Ontario Paper Co., explaining a chart to the Ohio Section during his talk on "Radioisotopes in the Paper Industry"

Fifth Coating Conference

Technical Association of the Pulp and Paper Industry

Poland Spring House,
Poland Spring, Me.
May 24–26, 1954

PAPERS PRESENTED AT THE 1953 CORRUGATING CONFERENCE

New York, N. Y., Oct. 15, 1953

The Relationship of Printing on Corrugated Boxes to Advertising and Sales

P. A. FITZSIMMONS

More than ever, the corrugated shipping container is being considered as part of the family of media that consumers are using to advertise, promote, and help sell their products. The newspaper ads have been run, the magazine, radio, and television programs have had their innings and now the corrugated containers scream "Here it is," "Come and get it."

If its contents are a food product, chances are good that at least 80% of the presentation will be made in the corrugated container, and better still, the grocery order is loaded into the empty container for Mr. Customer to take right into his home. If it's a beverage, the case is part of the order—you can't go home without it.

So, it is pretty obvious that packagers now recognize the unsophisticated shipping container as a very important part of their over-all customer presentation.

Now, what about its value as an advertising medium?

In the four major types of advertising, it doesn't generally appear to fit into the "pioneering" class where a product must be presented and sold to an entirely cold audience—where it has to find consumer acceptance; it doesn't appear to fit into the "retentive" class of keeping people sold for repeat sales revert to the merchandise in today's market and no amount of promotion will keep selling an unacceptable or unpopular product. It doesn't fall into the "competititve" class, for this type of advertising many times uses argument and reason in order to convince—obviously this type of selling takes time and space. But, it does fall into the class of "reminder" advertising—constantly repeating names and slogans—quick, easy reading eye catchers that take but a fraction of a second to establish their message. In a sense, they function similarly to billboards—to be quickly seen, read in passing, and remembered.

How much sales volume results from this advertising, or how well its job is done would be difficult to answer generally; but nevertheless, printing on corrugated boxes will never be discounted as an unimportant phase of product advertising in any sales alert organization.

How much sales value could be attributed to corrugated box printing would be easier to answer. There are products, for example, displayed in corrugated containers in housewares departments of the nation's busiest department stores, stores in which counter space is meted out by the square inch—here the container is used to remind the prospect of the product's features—it would be easy to count the printing's value.

It would be hard to conceive the budget-wary, highly competitive, market researching, soap and detergent manufacturers presenting a highly touted product in a plain box, or when they offer a product as new, they new it here, and new it there, and scream and sing its newness until Mrs. Housewife just knows it's new—what a letdown would it be to have it finally presented in a plain shipper—Mrs. Housewife would ask herself, "Is this the new or isn't it?"

Or what about the brewer who would sell his product in a plain box. Doesn't he have enough volume in sales to print his boxes? Isn't he proud of his product? No, the advertising and name repetition value is accepted and acclaimed by the industry as being good.

I believe this industry is among the leaders of those whose product hasn't changed much over the years, but who must continually make efforts to present it anew—to new markets, to new people every day. One of their avenues of approach is the container. They keep it moving through design changes and colors. They keep it fresh and prosperous looking. They keep it tuned to seasons. They recognize the value of having their product offer a pleasant greeting when it's right in the hands of their customers.

I am reminded of the wood chopper's story: Standing at the base of a huge redwood tree, the woodsman is dwarfed by the giant. His axe is a tiny, insignificant thing by comparison. As he swings his axe into the trunk, the bite of the tool rings through the forest and from the bite, a tiny chip falls to the ground, hardly noticeable, while the tree stands solid and firm, unmoved by the blow. The axe swings again and again and with each swing a new chip falls to the ground. Finally, the repeated pecking has widened the cut and the giant crashes to the ground, conquered by the repeated efforts of the tiny insignificant thing. And so it is with "reminder" advertising.

Its value truly lies in pecking away at its giant, the public, pecking so that finally she topples...and in toppling, just as a giant tree opens a path when she falls, so the purchase of one product of a company may easily open a path to others in the family.

In planning container printing, it is sometimes difficult to overcome the "message hungry" overzealous customer, who, having been convinced of the value of box printing, now wants to include everything that has ever been said about his product. It's not that we are against his messages, but we do have to work with the limitations of the media involved, and, in order to finally present him with cases he will be pleased with, these limitations must be considered.

First of all we are printing with rubber and rubber is displaceable...careless handling of fineness of detail can easily result in closed-in lettering or smudgy pattern work. It stretches, too, and distortion must be guarded against. Where large solid areas will require a soft durometer rubber, this same softness will permit small lettering or ruled lines to wobble. If the run is long or repeat orders would determine the choice of a molded die, these latter factors are easily controlled by proper selection of vulcanizing rubber while with use of rubber for hand-engraved dies little durometer manipulation is possible. To Mr. Customer these factors are of no concern. He's seen printed boxes and he wants some too, but they are serious factors to you and to the die maker.

We might here ask when should a molded and when should an engraved die be used? Our first answer is obviously "use

A. Fitzsimmons, Jas. H. Mathews & Co., New York, N. Y.

the molded," but we say that for more than the reason that we can get repeat business from the mold we have. When we mold a die we first produce a master, and the master can be worked to perfection. Then we can control over-all thickness, which you will recognize is very important. In addition, we produce an homogeneous product with the design matter, lettering, and background as one. Moreover, the master is many times subject to alteration and changes can be made. Finally, duplicates are quickly and economically made for one or several suppliers. From the corrugator's standpoint, he mounts a substantial product—from our standpoint we have produced a superior product, and from the customer's standpoint, he gets a better, more uniform, yet fully flexible job.

Ideally, arriving at the best solution for a well-printed corrugated box is a matter of teamwork. Cooperative teamwork between the consumer, the corrugator, and the die maker. When this combination works together, the consumer has a much more understanding view of how he can be assured a good looking box. The corrugator has something to sell other than his boxes, he actually offers a sales service aid in helping plan merchandising, and the die maker feels the intent of the printing—he envelops the urgency of the program and he accepts with sincerity the importance of being a part of a planning program. Actually, the entrance of the die maker into the sales picture can begin during the box salesman's approach, not in person, but as a sales tool—consider several corrugated box salesmen approaching an account competitively. With all box factors being equal—the test strength, the board quality, the price and the delivery, obviously the box house offering the best printing service will emerge with the order. Then, once the service has been sold, the die maker works as a tool of the corrugator in effecting the design and dies that will do the job.

Now, good design and good dies do not necessarily mean a good result in printed boxes. For we have all seen poorly printed boxes from faultless dies. Just where the difference in result can be placed is a matter of concern. First of all, there are people involved, and people are subject to variation. Printer slotter operators, for example, sometimes just grow into jobs titled "printer"—yet we all know the ramifications and qualifications of becoming a printer.

With the use of softer rubbers, more critical inking problems due to overprinting and trapping, and chiefly the production factor of sometimes printing hot, damp, board with its possible variables and tolerances, a pressman cannot expect to set a production time schedule, start the slotter, and let it roll.

Yet, who is at fault if the care with which a job has been sold and designed is not transmitted down the line to the men whose job it is to send the boxes on their way to the shipping door? Unless each person handling the printing of cases knows and accepts the responsibility of his company's obligation to the consumer, we will continue sometimes to get poorly appearing printing. This fault is not peculiar to the corrugated industry nor to printer slotter operators. We experience it quite keenly ourselves. For unless the commitments and agreements of the die salesman and design artist are properly transmitted to the engravers, vulcanizers, typesetters, and finishers—unless they absorb the importance of a perfect job—the resultant rubber die can be a bitter disappointment to many, many people, not to mention the serious damage to our sales position.

Over the last 5 or 6 years we have noticed a trend of large manufacturers with multiple products toward recognizing the importance of packaging engineers as more than container designers. Now we recognize that the world's best container designers are in the corrugated industry, otherwise they would not be the industry they are, but packaging programming within manufacturing plants goes on constantly.

While packaging engineers are conscious of the realm of their sales departments and are continually reminded of the high position of their advertising department, they nevertheless are themselves part of a production team. When the responsibility of having proper containers ready at just the right time, in just the right amounts, when the burden of damageproof fully protected shippers is their life or death, when they have the mountainous burden of carton inventory constantly in mind, they look on carton printing as just an added burden to their already unbearable load.

Here the design artist who understands the production problems of the corrugated house can offer a tremendous service.

From experiences in recent years, there are examples of food companies with 50 or more products to be packed and shipped, electrical product manufacturers with products small as toasters to those as large as freezers; machine and small tool manufacturers, and others all with the same problems—packaging; identification; sales message!

Assembling all the factors, the design artist, by careful study and planning makes sure the sales message is promoted; he includes the family relationship the customer strives for; he calculates the variations of sizes and products in order to supply the corrugator the least amount of changeable factors, reducing his production tie-ups. And, he plans all this with one intention—having the customer ship his products with the thought that if they do not sell—it certainly wasn't the fault of the containers!

We will never be rid of the consumer, however, whose box needs and whose merchandising measures cause production difficulties. The on-the-press off-the-press customer with a set of dies he changes every order, wanting an insert here, a new line added there, a new picture now and a border added later, so that the poor corrugator, much as he wants the business, has a hard time trying to supply good looking boxes. How can he possibly keep dies properly when they are mounted, removed, remounted, stripped, partly new, mostly old? Contrast that type of account with that where the dies are one piece, mounted on material rather than liner and grommeted and numbered, then hung in a clean die room ready for use in a moment's notice. They are easy to clean after a run by immediate soft scrubbing in a good cleaner and wiped dry.

I have been in die rooms where tier after tier of boxes containing unmounted dies cause a real scurry of hunting, piece by piece, when an order comes in—and half the dies have been stuck together with old ink poorly cleaned; and I've been in others where a simple reference to a numbered card file is the answer to finding properly hung mounted dies.

It would be foolhardy not to recognize that the more operations we add in trying to maintain ideal die room conditions surely add costs to corrugated printing production, but where are these costs to be placed?

I'm not familiar with corrugated pricing customs, nor does anyone in our organization claim to know the business, but I have been told by corrugators what their practice for printing is, and the stories range all over the lot. Some say they print free, some for 50¢ a thousand, some print two colors the same as one, others may get as much as $1.50 per thousand more for a second color. Now, since I don't know from actuality, I accept these figures, yet I can't help but compare in my mind the purchase of paper and printing in the corrugated field with paper and printing in others. Surely corrugated printing charges are negligible.

If we accept the value of printing on corrugated, and the nation's manufacturers have placed a value there, then the importance of printing must be compensated for by the consumer—for he realizes the value.

Examine the trends in recent printing developments to qualify this need for compensation. Colored liner is expensive—not usually a stock item, and over order inventory is hard to move, so we produce a rubber die of an over-all design

which in essence produces a colored effect to container board. It's true the dies cost more and the consumer pays that cost, but does he accept the extra care and responsibility that you must exercise to duplicate a colored board with ink and rubber? Your speed is diminished; your wash-up causes down time; your pressmen guard pressure control, and fountain care demands technical skill. Shouldn't the value of such skill and determination for perfection be transmitted in dollars and cents value to the recipient? It is in other printing fields.

We frequently have contact with box users without the benefit of a representative from a corrugated house. In the consumer's desire for an outstanding package, he sometimes plans without complete regard for the box printing production.

Recently, the halftone reproduction has been asked for with increasing interest—and when we are asked if we can reproduce their design using this technique, we reply that we can—however, and we use a big however—reproducing the die is the easiest part of the whole scheme. The conditions of the corrugator are the ones to be considered.

First, his printer slotter should be in new or perfect condition, cylinders true and correct, fountains adjusted, pressure rolls exact; the operators must want to produce a good job; the inks must be suitable for fine printing and time and space must be available.

The best results we have seen have been run as sheets with slotting and scoring done as a separate operation and at press speeds about one-third to one-half normal running speed. Adding these together we can only repeat—if the value of corrugated box printing has been faithfully appraised and the intent of the consumer can be satisfied by such care and concern—then the responsibility is ours and can be met, but the burden is his and should be borne!

Good box printing pays. If you attended the last Spring ber container association meetings in Chicago and observed the printing competition exhibit there, you would have become immediately conscious of one outstanding fact—it is going to take something more than just good *plain* boxes to satisfy Mr. Customer's desire to outshine his competition—it's going to take good *printed* boxes.

Future Printer-Slotter Design and Developments

E. B. SEEGER

In discussing future printer-slotter design—especially as it relates specifically to printing—it seems desirable to limit myself to those developments which appear to hold promise for the immediate and foreseeable future rather than to gaze into a crystal ball for a forecast of what will be 5 to 10 years hence—tempting as that may be. It is, therefore, my feeling that the matters on which I shall touch shortly will be on hand in a year or two at most, and will be in fairly wide use—certainly within 3 to 4 years.

INK FOUNTAINS

The ink fountain, as we now know it, has, in essence, remained unchanged for many years. There have been, of course, improvements and refinements, without changing basic principles. It now appears, however, that we may find changes being made which, although leaving fundamentals unaltered, can hardly be classified with the relatively minor maintain improvements seen in the past.

I believe one of the simplest and most effective changes will be the manner of driving fountain rolls. The present intermittent ratchet drive has served well but appears incapable of handling the very heavy pigment inks with which we are now confronted, and which will come into increasing use under the stimulus of added display work volume and customer demand for better and fancier printing on almost all types of corrugated boxes.

These heavier and much more viscous inks require considerable, in fact almost continual, mixing and agitating to prevent a further increase in viscosity, and in order to carry the ink through, operators are compelled to run with a rather free setting of the fountain blade. This permits the ink to come down through the fountain erratically, and almost in gobs—like putty. Good printing under these conditions is almost impossible.

By driving the fountain roll separately and continuously by means of a variable speed drive, and providing an adjustable surface speed of some 50 to 500 f.p.m., far higher than we are now using, we can create the hydraulic forces necessary in the fountain to insure completely homogenous ink. In fact, what we are doing is developing conditions very similar to those used in an ink grinding mill. Moreover, such an arrangement will permit a very close fountain blade setting—one which insures that a very fine and absolutely uniform film of ink will be carried through the entire mechanism and yet still of adequate volume to provide heavy coverage.

Of course, the advantage of having an independent drive which will idle the ink fountain when the press is shut down, is readily apparent on very quick-drying inks.

I believe we will also see the remainder of the fountain provided with a separate and rather special drive—one which permits running the doctor, distributing, and form rolls when the press is inoperative, and yet which will be driven by the press at press speed during production.

We will also probably see the form rolls provided with means, probably hydraulic, to remotely and instantly raise them from contact with the dies, and of course, by means of the same control valve drop them down into running position.

Experience has proved that when a fountain filled with ink is permitted to run without dies on the print cylinders to take the ink away, or with the form rolls removed, a film of ink builds up rapidly on all rolls to what might be called a saturation point. Beyond that point, additional ink does not build up on the rolls, simply because as a surplus flows out of the fountain and is rejected by rolls already covered with ink, it flows back up to the fountain, having no place else to go. This saturation point, happily, is well below that level at which centrifugal force overcomes film strength, with resultant spray.

With the separate drive on the fountain roll, a separate drive on the rest of the fountain and hydraulically actuated form rolls, we can turn this phenomenon to good use—we can cut down fountain setup time and reduce waste. As the slotter end is being set up—the press, of course, not running—the operators can start up their independently driven fountain rolls, hydraulically lift the form rolls from the print cylinders, and start up the separate drive idling their doctor, distributing and form rolls. Thus with the entire fountain running, even though the rest of the press is shut down, roll clearances can be adjusted and fountain blade set to get proper ink distribution and flow. No more will we see the spectacle of a press running for the first several minutes on a fussy ink job with the operators continually adjusting their fountain, meanwhile making waste or at best, boxes which are of inferior quality.

I believe that we shall also see in conjunction with these changes mentioned, a vastly improved fountain blade—one in which the keys are completely eliminated. The blade will be instantly and uniformly adjustable, all the way across, probably by means of a series of cams mounted on a cross shaft, provided with a micrometer worm adjustment. Thus we will have ink all the way across the rolls instead of limiting

E. B. Seeger, S. M. Langston, Co., Camden, N. J.

it, by use of fountain blade and dams, to a width slightly greater than die size.

This will not create a problem of ink spray as we now know, nor will it increase wash-up time. At the end of a run, the press is shut down and setup on the slotter end is started immediately. Meanwhile the form rolls have been automatically raised and the two separate drives on each fountain started. The fountain blade is quickly and easily brought up tight to the fountain roll, wiping it dry. Running the fountain roll dry will quickly start the ink flowing up from the form rolls to the distributors, to the fountain roll, and back into the fountain. In a very few moments the entire ink mechanism will be clean to a point where a quick wipe is all that is needed.

Some plants clean their fountains this way even now, with the present key type of fountain blade, but in so doing they destroy blade setting which can only be properly restored while the entire press is running, and which of course, precludes setup of other elements.

Thus the improved ink mechanism, as I see it, will permit a far better printing job with a wider variety of inks, and will permit quicker and easier setup and clean-up.

Moreover, it does not seem unreasonable to expect that the changes touched upon may permit the complete elimination of the doctor roll and its attendant difficulties of adjustment and clean-up.

ANILINE INK

Another rather significant development which appears very near is a printer-slotter arranged to handle aniline inks—in fact, one such machine is now in operation, and experience thus far is very encouraging.

Early aniline inks lacked finish and opacity—the colors were not light-fast—they bled in water and into a second color when overprinted. These problems have been overcome with today's pigmented aniline inks which are available in various degrees of opacity and are light-fast. Progress is also being made in developing gloss.

On the other hand, the box maker finds himself being called upon in increasing measure to furnish boxes with colored liners. He finds that many times his press speeds are dictated by the rate at which various inks dry. With increasingly competitive conditions developing in our industry, these factors, added to the attractive cost of aniline inks, lead me to believe that we will see a larger share of shipping containers using these inks.

Consider for a moment colored liners. Many plants have simply had to pass this business up—and very attractive business much of it is. They feel unable to spend the money and allocate the floor space for a coloring machine. To go out and buy colored liners is expensive, and of course, creates an inventory problem. Moreover, colored liners do not lend themselves to a double cut-off operation. How can you match orders to run on the double cut-off when one of them calls for a light blue outer liner? Thus corrugating machine efficiency must be sacrificed.

I need hardly dwell on what the possibilities and effects on our industry will be when the aniline printer-slotter comes of age. Imagine being able to color or tint the entire blank on the first ink fountain and in the same pass, print right over the quick drying aniline ink with conventional oil inks in the second fountain!

All of us have dreamed at one time or another of a continuous line operation for such work as can boxes or other large run items. Isn't it true that one of the stumbling blocks is the drying rate of ink? Surely the aniline ink fountain solves in part this knotty problem. To what extent other hurdles in the development of the line operation will be overcome in the foreseeable future is anyone's guess, but I feel sure that the day will come when we will see a few line operations in our industry.

Now to the probable design of the fountain itself, which of course, machinery builders will have to arrange for installation on existing printer-slotter equipment, as well as include in new presses where required. The nature of these inks dictates in very large measure the design of the fountain. We must handle a fluid instead of an extremely viscous or pasty ink, we must handle an ink in which finely ground pigments are dispersed in a solvent, generally water, for the porous stocks used in our industry, but occasionally more volatile solvents are used, and we will handle an ink which dries principally by absorption.

We will not require a multiplicity of rolls to distribute and break down the ink in order to obtain a uniform film for printing. The very low viscosity of aniline inks makes this unnecessary. Two rolls are all that are needed—one a rubber-covered steel roll and one a finely engraved steel form roll. These are carried in antifriction bearings and arranged in eccentrics so that the pressure of the rubber-covered roll against the engraved roll can be adjusted. The liquid ink flows into the nip of these two rolls at one end and out the other end, continuous circulation being provided to insure that precipitation of the finely ground pigments will not take place. The etched form roll will, of course, apply ink directly to the dies mounted on the print cylinders such as we now know them. Adjustment for quantity of ink will be simple, rapid, and accurate, the operators having only to adjust the pressure of the rubber roll, and means will be provided so that when the printer-slotter stops the form roll is automatically lifted away from the print cylinder and a small gear head motor comes into play to idle the entire ink mechanism which, under production conditions, is driven from the press at press speed. Of course, the ink reservoir will be enclosed to prevent loss of volatile solvents.

The engraved ink roller or form roll which picks up a measured film of ink and transfers it to the printing dies will insure a uniform film thickness of ink, quite independently of press speed and other factors. These engraved rolls, called Anilox rollers, were developed by one of the large ink manufacturers, and equipment using this system of ink distribution is generally referred to an Anilox printing.

FOUR COLOR PRINTING

The next major change which I look for in the not too distant future, is the means to economically handle three and four-color printing. I am sure most of you have encountered customer requests for this sort of work. Some of you have passed it by—others have handled it in the traditional time-consuming and costly method of passing the blank through the press a second time. A few have salvaged old long way wooden box or solid fiber printing machines which do a fairly respectable job, but they are slow, limited in size and speed, and lack the modern refinements which make it possible to handle run-of-the-mine two-color work efficiently. Moreover, they are wasteful of floor space.

I do not believe we can reasonably expect the development of a successful and practical three or four-color printer-slotter. Such a machine would be very expensive, not only because of its mechanical complexity, but also because the market for such equipment would be rather limited for the next several years, and hence its development would have to be borne by a relatively small number of machines. A four-color press would be extremely difficult and time consuming to set up, it would be awkward to work on, difficult to maintain, and like the long way wood box printer, rather inefficient on regular one or two-color work. There is also a real question as to whether a gear train of the length and type required for such a machine could be designed to give close register printing between cylinder no. 1 and cylinder no. 4.

It is clear, however, that means must be found to more efficiently handle the increasing volume of three and four-color work facing our industry.

I believe the solution will be found in means to tie together in tandem fashion, two printer-slotters of almost conventional

esign. In fact, we can expect to use for such an arrangeent, existing equipment on which certain modifications will e made.

These two presses will be arranged, one behind the other, pproximately 30 to possibly 40 ft. apart. The first press will eliver sheets, printed in two colors, but not panel scored or otted, to special retractable conveyor equipment which will eliver the sheets to the feed end of the second press where he third and fourth color will be added and the slotting and oring will be done.

The special conveyor between presses will probably carry he sheet in perfect register, or alternatively, means will be und to disregard register in this conveyor and re-register the ank in the second press.

It is for this second machine that we can expect the delopment of a rather special feeding mechanism. It must e capable of not only retaining or possibly even restoring regter, but must do so without smearing the ink laid down by ess no. 1. Therefore, any hopper in which sheets are piled he on top of another, will of course be quite useless.

Feed rolls will also have to receive attention, but this does ot appear to be too difficult since the use of laterally adjustle upper feed collars instead of a full width rubber covered ll, will probably do the trick.

The drive between presses will, of course, have to be synronized if it is found necessary to carry the blanks from one achine to another in perfect register. However, here again, y means of either lineshafting with a positive disconnect lutch or sectional drives maintaining perfect register, such are used on paper machines and textile equipment, will me into play.

This tandem arrangement of presses will offer a number of al attractions, among which are: minimum capital expendire, salvage of existing equipment, ease and rapidity of up, and because of the retractable nature of the special nveyor and the design of the feed mechanism on the second ess, complete, almost unhampered flexibility to revert both achines to handling, quite independently of each other, regar one or two-color slotted cartons.

I also feel that the experience gained and lessons learned m tying two printer-slotters together as described, will aluable in tackling the goal of all of us—a real line operan from rolls to finished boxes.

Printing Inks for Corrugated Containers

W. E. MONTOUX

In recent years, the printing ink industry has adced rapidly, paralleling new developments in the allied ds. Increased press speeds, new stocks, new coatings, v drying requirements, improved dies, and more stringent cifications on ink properties have necessitated almost olutionary changes in the science of ink making.

n discussing the subject of printing inks for corrugated tainers one finds that there are essentially three fundantal types in current use.

The first type is represented by conventional oil inks and perhaps the type which is most commonly used. Inks de on this basis are formulated from drying oil–resin comlations, driers, compounds, and pigments and depend upon oxidation of the vehicle for drying. Conventional oilled inks can be made for flat or gloss applications and, cept where special requirements prevail, are subjected to least limitations. The drying time of these inks will vary pending upon the stock used, the pigments employed, and finish required. Flat inks usually dry in 8 to 12 hr. while ss inks dry in 4 to 6 hr. In most instances these inks are formulated to be press-ready but occasionally adjustment is necessary. For minor reductions on flat inks, the use of small amounts of linseed is suggested. For gloss inks, special reducers are usually recommended by the ink manufacturer. These inks are prepared with vehicles which have no harmful effects on dies and all solvents which may be employed must be studied and evaluated accordingly. Since inks of this type are in such widespread use, it is possible to formulate from an almost infinite variety of combinations depending upon the specific requirements.

The second type in use is moisture-set which dries by the principle of precipitation. This is perhaps the latest innovation and is ever finding new uses. This ink is composed of pigment and a special vehicle. The theory of this ink is based upon the selection of a water-insoluble resin soluble in a solvent which is miscible with water. This solvent is extremely hygroscopic and acts as the conductor of the moisture which it picks up from the surrounding atmosphere or which is introduced by some external mechanical means. At a definite point the resin exceeds its tolerance for the water and consequently precipitates thus binding the pigment in a continuous film.

Moisture-ink has found so many applications it might be well to expand upon its merits. First, since it does not depend upon oxidation for drying, it can be truly described as the only letterpress type of ink which is odorless. By contrast, the previously mentioned oil-based type depends upon the action of the drier on the oil to facilitate drying. During the process of this chemical reaction, a gaseous odor is given off as a by-product. Moisture-set ink contains no drier nor drying oil and therefore forms no gaseous product which could cause odor. Through the medium of this property it has been found to be particularly suited for the packaging of many food products. This application is limited to those food products which show no resoftening effect on the printed film. In the corrugated field, moisture-set inks have been found to dry satisfactorily without the aid of an external drying system. The stock itself usually contains sufficient moisture to set the ink. Even in this case where no steam is used, the drying time is considerably less than that of the conventional oil type. If instantaneous drying is required, external drying systems are essential. The time of air drying for any moisture-set ink is governed solely by humidity conditions prevalent at the time the ink is printed.

As in the case of most specialty inks, moisture-set inks are subject to some limitations. This type of ink cannot be universely produced to give a high gloss although there have been some instances where special stocks have been run with specially formulated moisture-set inks under highly controlled conditions to give a considerable amount of gloss. Generally speaking, these inks can at best be expected to give a "sheen." Another limitation is that moisture-set inks necessarily require the use of rubber rollers because of the nature of the solvents employed in their formulation. Since corrugated printing uses rubber dies, this type of ink causes no plate problem.

The unique functional principles of the vehicles employed in moisture-set inks make possible several distinct advantages. Moisture-set inks can be formulated to give uniformly flat or velvety finishes with excellent covering and rub-resistant properties. Another asset is that these inks may be used with "moist" or "wet" stock without fear of the drying problems which may arise when oil-based inks are used. These inks are also well suited for quad machine applications.

The third type ink, a comparatively newcomer to corrugated printing, is the flexographic or aniline type. This type of ink dries by the principle of evaporation. Its formulation employs coloring matter, binder, and a carefully selected solvent combination. Basically, a flexographic ink depends upon a fluid, fast drying system to be used with flexible rubber plates. It is regarded as the simplest and most versatile

E. Montoux, Sinclair & Valentine Co., New York, N. Y.

system of rotary printing. Oddly enough, the aniline dyes which gave flexographic printing its original name of "aniline" are seldom used today in rotary rubber plate printing. Scientific research and practical experience have developed entirely new and different inks over the period of the past 20 years. Approximately 80% of the currently manufactured flexographic inks are pigmented. This makes possible the necessary opacity for ordinary corrugated printing. These inks are available in practically all colors.

Pigmented aniline inks consist of finely ground pigments dispersed in a solution of solvent and resins formulated to give desired results. These inks are normally press-ready fluids but in many cases they can be advantageously shipped in concentrated toner form.

Dye inks of the flexographic type consist of alcohol-soluble dyes dissolved in a resin system. All dyes are transparent and most of them are fugitive to light. The few available light-fast dyes which are sufficiently soluble and stable for flexographic printing do not give an adequate color range. Since these inks are transparent they are not particularly suited for use in corrugated printing. Our experience indicates that if dyes are used at all in corrugated inks, they are used in combination with pigmented types.

Certain other types of flexographic inks are made on an emulsion basis. These are used advantageously in cases where porous conditions exist in the stock. This type of ink is primarily chosen for work of a specialty nature and is only suitable for use where a flat finish is desired.

The process of inkmaking is constantly developing into a science which involves the most intricate combinations. The magic touch of chemicals and physical knowledge has transformed what used to be an art to a highly technical process. Early formulations were built around drying, color shade, and printability. Today these same cardinal characteristics are of primary importance but they must be studied and controlled with utmost effort. Research is being conducted in the fields of drying and nondrying oils, resins, plastics, and pigments in a relentless search to improve the quality and economy of the materials used in ink manufacture. No longer are the eye and finger the gages for printing ink characteristics. These have been replaced by mechanical and electronic devices which are capable of detecting deviations beyond the limits of the human senses. Control has become the key to better inks.

In formulating any type of corrugated ink, there are several basic concepts which must always be taken into consideration. First, the ink must have the necessary drying characteristics to facilitate handling. Next, the opacity must be such to cover the color of the board. Third, money value, coverage, and general working properties must be taken into consideration. In order for us to see how these properties are brought into being, we shall discuss some of the ingredients and their inherent properties which are utilized in the formulation of corrugated inks.

Some 30 years ago, the main source of pigments used in this country were of European origin. In this relatively short span of years, American research, ingenuity, and scientific development have developed our pigments to a point where they are second to none in quality. These ceaseless efforts have made available colors which possess much greater tinctorial value, are cleaner and more brilliant in shade, and which show improved light resistance and greatly improved wetting or dispersion characteristics. All of these properties tend to make possible sharp, brilliant, eye-catching printed colors that we know today. Color has become the magnetic symbol of current-day packaging and advertising.

It has been suggested that I mention some of the properties of inks which are primarily related to the pigments. A pigment can be either opaque or transparent. Opaque pigments are generally those derived from inorganic sources. Some of these would include titanium dioxide, chrome yellow and oranges, molybdated oranges, earth colors, and cadmium colors. The chemical nature of these pigments is such that they display good permanency and relatively good resistance to bleeding in many solvents. Through the means of highly developed processes of refinement, these colors have been developed to a point where they offer good working characteristics in a printing ink. Abrasion effects on engravings due to the coarse particle size of these pigments have all but been eliminated. Perhaps the primary purpose for these opaque colors is to obtain coverage. These are extensively used to prevent the "show through" of the underlying stock. This permits the brilliant display of color on stocks used in corrugated work. Opaque colors cannot be used for multicolor work except for first-down colors.

The transparent colors represent a much broader class and are the results of organic chemical reactions. Because of the lighter specific gravity, these pigments are generally found to offer better press characteristics. In addition to their greater tinctorial strength, these pigments are generally of a finer particle size which tends to preclude such press trouble as piling on the rollers or plates due to insufficient dispersion. They also carry better and usually give a greater mileage factor. Transparent colors in many cases are not quite as resistant as the opaque groups but many have been developed which display excellent light-fastness and other chemical resistances. Generally speaking, transparent colors are cleaner, thus making them excellent for multicolor work to produce the brilliant intermediate shades. These colors are also used to a great advantage in the production of gloss inks since their surface treatment helps to enhance the light reflectance characteristics of these colors. In printing on coated liner, these transparent pigments permit additional light reflectance and brilliance of color.

Pigment development has made possible many colors which resist the effect of detergents and soap powders and many specialized products. In printing ink formulations pigments must be very carefully selected so as to consider subsequent operations. Where such properties are involved, it is good policy for the printer to rely on the recommendations of the ink manufacturer when blending colors at the press. The knowledge of the pressman for manipulating a given ink to give the best press operation is always held in high esteem but in all fairness, he cannot be expected to thoroughly understand the complex mechanism of modern ink formulation.

Perhaps the latest development in the field of pigments is that of flushed colors. These colors are manufactured from the same pigments used in making a dry grind of pigment and vehicle but they employ a different means of dispersion. Actually the difference is that the pigment used in the flushed base is never dried out but is dispersed into a selected vehicle from pulp form utilizing specialized vacuum techniques. This process has made possible colors which are softer in texture, which are more readily dispersed, and which help the cause of gloss. They are particularly suited for fine line printing and screen work thus permitting cleaner work. Since most of the pigments considered to have a relatively hard texture are now used in flushed form, this new process has given the ink maker a tremendous lift in producing smoother and more easily dispersed inks. This greatly aids the elimination of distribution and piling problems traceable to the large praticle size of pigments.

For many years inks for corrugated applications were based upon linseed oil as the grinding medium which imparted the necessary drying characteristics to the printed film. Gradually, other drying oils found a place because of special advantageous characteristics. Tung oil, perilla oil, dehydrated castor oil, and other chemically treated oils are worthy of mention which led to better drying and better chemical resistance.

Due to the economic conditions prevalent at the conclusion of World War II, linseed and other drying oils became extre-

nely limited in supply. We, as well as other ink makers, ere prevailed upon to look to other sources in order to con- nue the supply of inks which would give good printing and rying without being materially restricted by the drying oil hortage. Various other synthetically prepared drying oils ere developed by chemical research such as drying petro- um oils, highly refined rosin oils, and other chemically eated drying oils. Many of these have now taken a per- anent place in the vehicle field.

Another outgrowth of the drying oil shortage was the de- lopment of synthetic inks. These inks involved the de- lopment of vehicles which utilized reduced portions of lin- ed and other drying oils in combination with chemically tricate resinous materials. Inks made with these vehicles re found to perform at least equally as well as the conven- nal inks heretofore used. With intensified efforts placed on refinements, these newly developed inks resulted in ster drying rates, increased finish, and sharper printed pressions. These inks made possible cleaner printing on t and absorbent stocks heretofore impossible with linseed based inks. Tests show that in many cases drying time s been reduced by as much as 50%. In addition, the in- ased brightness and finish of the synthetic inks have ered a greater visual appeal to the printed matter and have atly enhanced promotional possibilities. These develop- nts acted as a stimulant to the ever constant search for ver synthetic bases which in turn offer infinite possibilities.

This phase of development has resulted in considerable im- ovement in gloss inks. We have found through the means various resin developments, techniques to improve the rproofness and high-gloss characteristics. I think we can agree that these two factors are becoming ever more im- tant in the light of the constantly increasing demand for s attractive means of printing.

Better gloss inks are the result of the combined efforts of papermaker and the inkmaker. The paper people have n extremely active in the development of surface treat- nt techniques by including many of the newly developed erials currently available. The inkmakers themselves e exercised a concentrated effort to improve both the icles and the pigment characteristics with respect to gloss. ailed studies have been made in order to carefully select segregate these types of pigments that give the greatest t reflectance and gloss. Usually it is found that the trans- ent types of pigments offer the best possibilities for gloss. many cases the pigment surface has been given a selec- treatment in order to improve gloss characteristics.

h the vehicle field we have taken full advantage of the nite variety of resin and plastic materials available in order accomplish two ends. First, we have developed vehicles h tend to coagulate on a printing surface without exces- penetration which in turn results in a smooth continuous . This has in many cases helped to overcome many of difficulties associated with the "hills and valleys" present many printing surfaces. These resinous developments e given us truly hard, yet elastic surfaces which dry rapidly will withstand flexing without indication of undue brittle- . Second, we have studied waxes, silicones, polyethy- s, and other plastic materials which tend to give the neces- slip to the printed surface to prevent scuffing. These cles have found use in all fields, but more particularly ne packaging and corrugated fields.

Another factor worthy of detailed mention concerns the ng of modern inks. Along with stepped-up requirements aster drying inks came the problem of how to make the ink fast on the paper and yet remain open on the press. ough the medium of vehicle development we have found ssible to employ principles which involve the compati- ty of materials. Inks are formulated to remain com- ly compatible on the press but as soon as the ink film is sferred to the somewhat absorbent paper surface, part of the vehicle is absorbed. The balance of the printed film dries very rapidly by oxidation. Since driers cause rapid skinning and the use of volatile solvents cause tacking-up, the drying attributed to the complex vehicle structure becomes all important in the development of press stable inks. In addition, the ability to use such vehicles with reduced amounts of drier has done much to avoid overheating in piles. Since the drying oil-metallic drier content is carefully balanced in a prepared formulation, it is not usually recommended that drier be added to overcome conditions that may be traceable to another source.

One of the latest innovations in specialty ink is the daylight-fluorescent type of ink which is currently available for silk screen, letterpress, and gravure. It has also been in limited use in the offset field. Thus far, the best means of application has been by the silk screen method. Where gravure and letterpress application is preferred because of the length of the run, some sacrifice must be made with respect to the brilliance and loss of permanency. At best these inks, by nature of their chemical composition, can only be expected to withstand exposure to daylight for a period of approximately 30 days.

Heretofore available fluorescent inks required the use of a black light to activate their luminescent properties. The new inks are activated by daylight alone. There are two essential type of coloring matter in use, depending upon the means of application. The first type is designed for silk screen, letterpress, and offset applications and possesses the basic characteristics of a pigment. This pigment is essentially a solid solution of a fluorescent dye or combination of dyes in a thermosetting-type resin. The second type involves the use of a specially prepared vehicle and dye combination, together with the necessary extending pigments to give the proper refractive index for maximum brilliance. In actual application, the brilliance of these colors is primarily dependent upon three factors, namely, thickness of film, cleanliness and transparency of printed film, and whiteness of background. At present these inks are finding particular use in the advertising field since they offer extraordinary eye-catching appeal. It is significant that these inks are only applicable to white surfaces and at the present time applications in the corrugated field are limited to white coated board.

Another phase of inkmaking worthy of mention is the consideration of the quality of the ink versus the unit cost. It is well to mention here that our research efforts are constantly directed toward the development of better materials which will give economic as well as property advantages. I can only emphasize the importance of giving the ink manufacturer all the information necessary to any job so that he can select from his vast stock of materials those which will be best suited for that particular job.

In most instances the cost of the ink is governed by the properties required of that ink. In all cases the greatest change takes place in the selection of the proper pigments and vehicles. Regardless of the type of materials selected, each ink is prepared to give trouble-free operation of the press. By supplying the ink man with the proper information, he is able to supply the most suited type of ink which will give maximum performance. If limitations are placed on the ink, the inkmaker is considerably narrowed in his choice of materials and must in many cases resort to the use of extending materials which in turn affect the mileage that may be obtained from any given ink. In this day and age when press operation costs are high, the best definition of a good quality ink is one which possesses the necessary property requirements, gives trouble-free performance, good coverage, and good mileage. This has also proved to be the cheapest ink regardless of unit cost.

In recent years there has been a definite trend toward the development and use of instrumentation for the control of both the color and the consistency of printing inks. The

National Printing Ink Research Institute as well as several other educational institutions associated with the graphic arts have contributed immeasurably toward this end. Electronic devices are employed for color control. The Inkometer and various types of viscosimeters are being used to control viscosities of vehicles and for the successful control of ink bodies. Several other instruments have been devised to study stability and press characteristics so that adequate control over these factors can be maintained. For scuff resistance, the Sutherland rub tester has been found to give good results. However, several other good rub testing devices are employed to good advantage depending upon the application.

Ink viscosity and tack are extremely important in multicolor printing in order to insure proper trapping of the successive colors. The use of these instruments has aided tremendously but they cannot be considered foolproof. Conditions inherent to a particular stock or even to a press in many cases make minor additions necessary at the press. By experience the pressman has been very successful with minor additions to conventional inks since these inks are formulated with the necessary latitude. However, in cases where special inks are employed, it is good practice and is time-saving to consult the inkmaker concerning additives.

The National Printing Ink Research Institute is also studying material and equipment used in ink manufacture. This organization enrolls the membership of most of the ink manufacturers throughout the country. Its technical committee decides which problems are most pressing to all and consequently undertakes the fundamental study. In many cases it has been found that these materials are being studied for the first time solely from the standpoint of their use in printing ink manufacture. Their work is of course further supplemented by the individual efforts and problems of the laboratories of the ink manufacturer. It is our hope that they, together with the creative minds of the individual ink chemist, can develop products which will enable the printing ink industry as a whole to continue to give better and more economic service to our consumers.

Scheduling, Setup and Make-Ready, and Press Adjustments

STANLEY BAUGHMAN

When preparing the schedule for orders which are to be run in the pressroom, we are attempting to (1) run the maximum number of impressions with a minimum amount of down time, and (2) avoid congestion in the storage area behind the presses.

Recently the problem of scheduling has been somewhat complicated by the number of "hot" orders which must be expedited through the plant. For example, an order which is scheduled to run on the press at 5:00 a.m. suddenly must deliver at 7:00 a.m. In order to meet this delivery, it is then necessary to pull the order up on the schedule and, in most cases, destroy the continuity of the schedule. This seriously hampers production and material flow and results in higher costs.

A primary requisite when making the schedule is to have at hand all the orders which are currently in the storage area behind the presses and, in addition, those orders which are coming off the corrugator and the approximate time of their completion. When this information is at hand, we can then begin to select the proper press for the various orders.

One of the first considerations is the blank, i.e., the length, width, the depth dimensions (distance between the flap scores) and the spacing of the slots. These generally limit the order to two or three presses depending upon the size of the operation. The length tells us what presses can be utilized and th width determines whether or not skip feed is required. Th depth dimension further limits the number of presses avail able. Although a blank may fit two or three presses, insofa as the length and width are concerned, however, the dept dimension may be so small that only one press can adequatel do the job. The same holds true when considering the dis tance between slots.

The sheet size also determines whether or not two me will be required to feed the press. These orders which wi require a two-man feed can then be so scheduled that extr help from outside the department will not be required.

The next consideration in the selection of the proper pres is whether or not special attachments are required such a hand holes, punch holes, etc. Here again press capacity limited since all presses are not equipped with the specia heads, cutting dies, and knives due to the fact that thes tools are rather expensive, and this type of work is not o sufficient volume at the present time to warrant their pur chase.

Orders which are to be run two out also serve as a guid in selecting the proper press, since all presses are not equippe with the extra slitter and slotter heads.

When we have checked the previous items and have selected the proper press, our next consideration is the ink which i specified on each order, its type and color. By type we mea is it steam set or oil base. This is important since wash-up on the press are extremely time consuming and wash-ups o oil inks are more time consuming than steam set. Therefore it is not desirable to change from one to the other whenever i can be avoided.

Generally we start with the orders which specify the lighte colors and when a change is required, we attempt to follow up with a different shade of the same color or a slightly darke color. In this way, a complete wash-up of the press can b usually avoided.

The next item is the type of manufacturer's joint. Tim can be saved by scheduling tape containers to follow one an other, and the same holds true for stitched and glued con tainers. In cases where there is a conflict between order insofar as ink and the manufacturer's, generally the ink tal e preference, although there are exceptions.

We must also consider those orders which require a spec a setup such as hand holes, punch holes, two out, and ski feed. These orders should, whenever possible, follow on another, since these setups for the most part require addi tional time over and beyond the normal setup time.

These items which I have just mentioned can make a con siderable difference in the quantity of containers which ca be produced in a given time.

The setup, make-ready, and press adjustments undoubtedly play a major role in determining how the container will run in the finishing department, and also whether or not it wil satisfy the customer requirements.

The setup covers many details, all of which are important The wash-up of the ink rolls and fountain must be thorough particularly when going from a darker color such as red green, or black to light colors such as white or light yellow If the wash-up is poor the color to be run will be definitely off-shade and unsatisfactory.

The setting and alignment of the male and female scores is of the utmost importance, and the depth of the score should also be noted. Failure to follow through on these items results in a container which folds poorly thereby hampering the finishing department particularly when run on automatic equipment. Poor alignment of the male and female score may often result in cut scores.

On printer-slotters where the slotting wheel does not follow the score wheel, care must be taken that the proper line-up between the two is obtained; otherwise, the container folds poorly and will be out of square. The positioning and fasten

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ing of the dies is important with respect to register and over-all printing. If there are low spots on the dies, make-ready must be used to bring these up to uniform height.

The dies should be attached adequately so that portions of backing sheet will not deposit ink smudges and/or staple marks on the container.

The fine type should be properly aligned in order to prevent unevenness or distortion. Sloppy workmanship in this respect can ruin an otherwise good print job.

As the various orders are run through the press, there should be a constant adjustment of the feed roll, pull rolls, impression cylinder, slotter and slitter heads in order that excessive crushing of the board does not occur.

The feed roll is undoubtedly the most important since this has contact with the entire sheet. When the feed roll is not set properly the corrugations are crushed, and the finished container will have low flat crush and the over-all compression strength will be decreased. The pull rolls, of which there are two sets, are generally placed at the extreme edges of the blank. When running stitched or glue-lap containers, it is desirable to crush the board in this area in order that the container when bundled will not have a tendency to "belly" and therefore not stack properly.

The amount of impression produced in the area of the printing dies is also important, since excessive damage may result in poor compression and stacking strength.

The slotter heads although rather insignificant to most of us must also be checked. If the heads are too close to one another, the board is crushed along the entire length of the panel score and the load carrying property of the score is certainly lessened.

The slitter heads may also damage the board when improperly set. This generally hampers the taping operation since the board is soft, and it is difficult to obtain satisfactory tape adhesion.

The adjustment of the hopper, stopper plate, and the feed section must also be made in order that adequate trim is obtained and that the finished sheets are not run short.

When these adjustments have been made, and the ink has been deposited in the fountain, the fountain roll is then rotated, and the operator sets the pressure blade so as to permit the correct quantity of ink to flow to the fountain roll and the form rolls.

Following this operation a trial sheet is run to check the dimensions, printing, scoring, register, feed roll, and pull roll impression and slotter and slitter head damage.

It is also essential that the container be set up since in this way, inherent defects not readily discerned may be observed. If any defects are found, the proper adjustments are made, and the order is ready to be run.

The Effect of Printing upon the Functional Properties of Corrugated Fiberboard Boxes

ALFRED W. HOFFMAN

The advantages of printing of corrugated fiberboard boxes—enhanced appearance, identification of contents, and dissemination of advertising messages—are not achieved without cost, both in an economic and in a functional sense. This paper is concerned only with the latter: to what extent are the primary purposes of the box—retention and protection of the contents during handling, storage, and transportation—impaired as a result of printing?

It is almost a truism that container resistance to hazards loosely covered by the term "rough handling" is reduced in a certain percentage of instances by the printing operation. However, it is practically impossible to obtain statistical data on this deterioration in such laboratory tests as vibration, revolving drum, incline impact, and drop. The multiplicity of variables; the complex interrelationship between container, interior fittings, and contents; the fact that in some specimens other container elements such as fingerlines or the manufacturer's joint are more vulnerable than the printed areas; and the relative paucity of experimental results which lend themselves to segregation of the printing as a factor for analysis present what appear to be insuperable barriers to this avenue of investigation.

Although some desirable approaches are blocked, advancement is possible by other routes of investigation. The influence of printing upon compressive resistance has been recognized for many years and broad evaluations were established well before World War II.

These evaluations stemmed from analysis of results of thousands of boxes subjected to empty compression tests. In brief, it was ascertained that rigidity of corrugated fiberboard boxes in both the top-to-bottom and end-to-end directions could be reduced as much as 20% by printing. This factor, naturally, represents the range between the two extremes of no printing and full coverage of most of the area of the container.

It was also determined that, although area of printing is a primary element in influencing compressive resistance, the character of the printed material and its location are also important. By way of illustration, it might be mentioned that straight lines or bands used as a decorative design or, perhaps, as a frame around other printed material are frequently major considerations impairing rigidity. Furthermore, the proximity of printed areas to the normal regions of buckling under compressive forces will have a vital bearing upon the resistance exerted by the box. A given printed design or legend positioned on an end panel will not have any effect upon end-to-end rigidity, for example, whereas the same printing centered on a side panel where it will coincide with the usual central girthwise buckle typifying end-to-end failure may have a profound effect.

It would be erroneous to leave the impression that good compressive resistance is inconsistent with printing. On the other hand, any one who has watched a box tested in compression and has seen the line of failure follow exactly the edges of printed material will appreciate the close interrelationship that exists between the two. If this correlation were more generally recognized there might be more care shown on the part of box users in specifying copy for printing.

Up to this point, no thought has been given to the element of the boxmaker's efficiency in carrying out the printing operation. In this connection we are not concerned with the criteria of register, gloss, color matching, etc.; these factors are obviously important but they have no bearing upon the functional properties as previously defined. Instead, the printing efficiency should be evaluated from the standpoint of crushing of the corrugated fiberboard.

Such a study was carried out by Container Laboratories this Summer on almost 200 groups of nominal 175 or 200-lb. test corrugated fiberboard boxes (with the latter certificate grade far outnumbering the former) which were submitted by various box manufacturers to either the New York, Chicago, or San Francisco laboratories. Aside from normal quality measurement, these lots were also subjected to special tests to determine the effect of printing upon the combined board caliper and upon the flat crush resistance.

It is true that the correlation of these two properties with container functional excellence is but imperfectly known. Nevertheless, it is generally accepted that it is desirable to have the caliper and flat crush as high as possible consistent with the flute of the combined board and the materials used in the fabrication. Furthermore, both of these characteristics can be measured with relative ease and simplicity.

Fred W. Hoffman, formerly Technical Director, Container Laboratories, New York, N. Y.; at present Quality Control Manager, Container Div., Gilbert Gair Co. Inc., New York, N. Y.

Table I. Distribution of Corrugated Fiberboard Groups[a] Evaluated with Respect to Flute and Type of Corrugating Medium

Medium	*A-flute*	*B-flute*	*C-flute*	*Total*
Bogus	0	0	4	4
Chestnut	5	4	6	15
Cylinder kraft	1	5	11	17
Fourdrinier kraft	3	18	1	22
Semichemical	32	36	32	100
Straw	7	7	25	39
Totals	48	70	79	197

[a] All 175 or 200-lb. test certificate grade.

The groups were selected for the special analysis in accordance with an arbitrary pattern based upon receipts at the respective laboratories. No attempt was made to influence the selection one way or the other with respect to box manufacturer, flute, materials, type of printing, or any other factor. Hence, the boxes represent a haphazard rather than a scientific cross-section of containers made during the middle portion of this year. As such, the findings should be regarded as indicative rather than conclusive. Comparisons among the three different flutes most likely are not valid with respect to either flat crush resistance or thickness because of the nonuniform representation of the different materials and because the amount and character of the printing undoubtedly were not the same for each flute. The distribution of the groups with respect to flute and corrugating medium is indicated in Table I.

All lots were subjected to an atmosphere of 50% relative humidity at 73°F. for a minimum of 24 hr. following exposure to a lower relative humidity so that moisture content equilibrium could be attained on an absorption basis.

Apparently the thickness of combined board will be reduced on the average approximately 6% by printing. While this is significant, it should be noted that the thickness of critical unprinted areas, as defined in the footnotes applying to the table, is usually appreciably lower than that of unprinted areas in the center of panels. Lower calipers in printed areas were, of course, the rule but there were a few groups where the thickness was increased, in one case as much as 0.005 in. It would appear that extreme crushing of the corrugations can reduce the over-all thickness by approximately one-fourth of the unprinted caliper.

Rarely do the different colors in a group with two-color printing have the same thickness and the biggest differential noted was 0.018 in. On the other hand, it is curious to note that, for all three flutes, the greatest caliper loss due to printing was not found on two-color printed boxes.

The flat crush figures are reported in terms of pounds per square inch for easy reference but the determinations were carried out on circular specimens with an area of 9 sq. in. On each group four tests were made on unprinted specimens—selected from undamaged areas as close to the center of panels as possible—and four were conducted on printed specimens. With respect to the latter, areas with the greatest amount of printing were preferred.

The deterioration in flat crush resistance due to printing obviously varies widely. Because of the considerations previously mentioned, it may well be erroneous to conclude that the average diminution in this property is smallest for A-flute and greatest for B-flute although there are indications that such may be the case.

The number of groups with an increase in flat crush resistance in printed areas was too large to be dismissed as an accident. This finding is buttressed by the fact that, for the best group in each flute, the increase was of significant proportions.

However, most lots suffered a loss in flat crush resistance due to printing and this decrease, in extreme cases, was more than one half of the unprinted flat crush resistance. This does not take into consideration the 13 lots, 9 B-flute and 4 C-flute, where the board in printed areas was so flabby that the flutes collapsed steadily when pressure was applied and defied determination of an end point.

In summation, the investigation reveals that printing usually but not inevitably has a deleterious effect upon corrugated fiberboard properties which are associated with good functional performance. The effect upon container performance, of course, is a function of the amount, character, and—at least insofar as compressive resistance is concerned—position of the printed material. There are indications, on the

Table II. Effect of Printing upon Combined Board Caliper and Flat Crush Resistance

	A-flute	*B-flute*	*C-flute*
Total number of groups analyzed	48	70	79
Average unprinted combined board caliper, in.	0.202	0.126	0.164
Average printed combined board caliper, in.	0.192	0.118	0.153
Average percentage loss in caliper due to printing	5	6	7
Average critical unprinted combined board caliper, in.[a]	0.184	0.121	0.154
Number of groups with printed caliper higher than unprinted	2	3	3
Greatest increase in caliper between printed and unprinted areas, in.	0.002 (1%)	0.005 (4%)	0.003 (2%)
Number of groups with printed caliper same as unprinted	0	2	1
Number of groups with printed caliper lower than unprinted	46	65	75
Greatest decrease in caliper between printed and unprinted areas, in.	0.049 (25%)	0.028 (23%)	0.041 (25%)
Number of groups with two-color printing	10	25	16
Number of groups with different caliper for each printing color	10	23	14
Greatest difference in caliper between two colors, in.	0.006	0.0018[b]	0.015
Greatest decrease in caliper between printed and unprinted areas, in.	0.023	0.020	0.020
Average flat crush resistance[c] of unprinted areas, p.s.i.	28.7	36.6	30.9
Average flat crush resistance[c] of printed areas, p.s.i.	27.5	30.5[d]	27.8[d]
Average percentage loss in flat crush resistance	4.3	16.7[d]	10.2[d]
Number of groups with printed flat crush higher than unprinted	16	6	18
Greatest increase in flat crush between printed and unprinted areas, p.s.i.	5.9 (19%)	2.2 (11%)	5.1 (17%)
Number of groups with printed flat crush same as unprinted	1	0	0
Number of groups with printed flat crush lower than unprinted	31	64	61
Greatest decrease in flat crush between printed and unprinted areas, p.s.i.	8.9 (57%)	14.7 (41%)[d]	30.3 (81%)[d]

[a] The over-all combined board thickness of that unprinted area which upon visual examination was most crushed by the fabrication. If no such areas were apparent, the lowest average caliper of any one of the following areas was used for the purpose: 1/2 in. removed from the center of the body score diagonally opposite the manufacturer's joint, 1/2 in. removed from the center of the top horizontal score, 1/2 in. removed from the center of the bottom horizontal score. The critical unprinted combined board caliper as used in this study has no significance except as a term of reference for evaluating the caliper of printed areas.

[b] The average caliper of one color was 0.014 in. lower than that of the unprinted area and the average caliper of the other color was 0.004 in. higher than that of the unprinted area.

[c] Circular specimens with an area of 9 sq. in. were individually measured in a Hinde & Dauch flat crush tester.

[d] On nine B-flute and four C-flute groups the flat crush resistance could not be evaluated since the flutes collapsed gradually with no definite end point. The printed flat crush in such cases was arbitrarily assumed to be 50% of the unprinted flat crush but these groups were discounted in determining the greatest absolute and greatest percentage decrease in flat crush due to printing.

her hand, that printing efficiency has a profound bearing on the impairment of the inherent strength characteristics the unprinted combined board. Furthermore, it appears asible to establish relatively simple criteria for evaluating inting efficiency from a container functional standpoint. hese criteria may be crude but not impotent weapons to be ployed in the continuous struggle of quality control.

Press Operation, Maintenance, and Control

HOWARD ROSEN

THE sun in relation to the planets can be compared to e press operation versus the entire operation in a corrugated x plant. For if the sun fails, the planets will cease to exist, st as the failure at the printing operation means ultimate x failure. In this instance, we can compare the sun to the ess operator, for each affects life. The sun is responsible for man life, while the press operator is responsible for the life the corrugated box. Therefore, we must always keep in nd the important role the press operator plays in meeting high standards of box compression and appearance as set th by our customers.

Now, let us discuss the factors which ultimately affect the per fabrication of the box when it is run through a press: nting crush, slotting and scoring of the box blank, and mming the trim length of the box blank.

n order to print the box properly and with a minimum ount of crush, it is essential to have dies which are in good dition. This means we must exercise a control on all s. In our plant, the man who mounts the dies is responsi- to see that the dies are not worn or excessively hard. s is accomplished by examination and the use of a durom-. If, however, this check does not reveal any defects, next check point is obtained when the job is actually run the press. Here, the press operator, upon running the determines whether or not he is obtaining maximum iency from the dies. In any case, faulty dies are im-diately brought to the attention of the press department man.

ollowing this one step further, the press foreman brings condition to the attention of the plant superintendent and sales department, who will authorize the replacement of uitable or worn dies.

ther critical points for the press operator to consider are ther the printing drums, ink rollers, ink flow adjusters, rings, and shafts are in proper working order. If any of items need immediate attention, the machine shop is acted at once. However, the following steps are taken nsure proper maintenance:

Spare parts are kept on hand in the machine shop at times to facilitate immediate repairs. These include es, cutting knives, slotting knives, and pull rollers. In case of trim knives and slitting knives, we automatically ge them every 8 weeks to insure running with the least unt of trim while maintaining a clean cut. The knives h were taken off the machine are brought to the machine and are reground. This procedure can be repeated two ree times before it is necessary to replace the knife blades.

The maintenance department handles the machine cation. They fill the oil cups in the morning and grease machines at night. This routine burden is taken away the press operator and insures proper machine lubrica-

A clean press is a requisite for a good printing job. efore at the end of each run the operator: (1) washes the ing cylinders with kerosene, (2) removes all staples from ylinder, (3) uses an ink wash to prevent the ink from dry-ing on the cylinders, and (4) washes the ink off the score and slotting shafts. However, after the night shift leaves, the wash-up crew comes in to clean the press. The procedure for washing rollers which are in poor condition is as follows: The roller is removed from position and then placed in a tank containing a 7 to 7.5% caustic soda solution for approximately 24 to 48 hr. After this bath, the roller is washed off with water and then dried. The final washing is done with a kerosene rag. It is important to note that caustic soda can cause a severe burn and must be used with caution.

4. After the above procedure, the rollers are ready to be returned to the press. When rollers are to be put away for indefinite periods, they are oiled and wrapped thoroughly with wrapping paper.

5. Several presses are thoroughly cleaned each week. During this clean-up, the entire machine is scrubbed with brushes and steel wool, using ink wash and kerosene.

6. Any maintenance problem that cannot be handled by the press operator or foreman is the concern of the machine shop. Repair slips are used to keep track of the repairs. Copies are sent to the machine shop and plant superintendent with the foreman retaining his copy as a follow-up.

To round out the maintenance program, weekly maintenance meetings are held with a panel consisting of the chief engineer, plant superintendent, plant electrician, master mechanic, and quality control engineer. At this meeting each one of the men on the maintenance panel reports the progress made on repairs in all departments. The foreman involved, in this case, the press department foreman, is called upon to report any additional repairs that have to be made in his department. The list of repairs is reviewed and a completion date is set by the member of the panel involved.

QUALITY CONTROL PROGRAM

Now that we've covered the maintenance program, let us review the next important phase—that of quality control checks at the press. (Demonstrate how easy it is to damage the fluting structure of a box by manually crushing a box in front of the group.) Perhaps this demonstration will illustrate how easy it is to crush the fluting structure of a box. This type of damage may very well result from applying too much impression on the printed areas. Furthermore, if we were to make a compression test on this particular box, we could expect the line of failure to appear through the damaged area. Therefore, it is very important that the operator and the foreman check the box blank for quality before and after printing. In order to make quality checks, the following information should be noted: printing coverage; original caliper of the board; feed roll, pull roll, and printing damage; and scores and slots.

As printing coverage is the first part of the box which is readily seen, we make this our first quality check. While reviewing the printing coverage, it is important to check the adjustment of the fountain flow to make certain that the printing is clean, crisp, and solid. The operator must avoid drowning the box which causes the impression to smear or bleed at the edges. It is equally important to keep the fountain clean, but on long runs, the ink, itself, should be changed to keep it free from dust.

Secondly, we must check for any caliper losses due to the press operation, as this will seriously affect the final strength of the box. To make checking easy, a caliper is placed conveniently between the presses.

All necessary adjustments are made during the run to correct any of the faults that are noted.

We check caliper loss in the following manner:

1. A sample of the box blank is cut away and calipered, while the remainder of the box blank is run through the press.

2. The caliper of the portion of the box which has not been run through the press is recorded.

3. The caliper of the printed, pull roller, and feed roller areas, is then taken.

RD ROSEN, National Container Corp., New York, N. Y.

4. The difference in caliper of the printed, pull roller, and feed roller areas in relation to the original caliper is noted, and compared to the standards.

We have established standards for all types of damages the box is subjected to while running through the press, namely, feed roll damage, pull roll damage, and printing impression.

The standards are as follows:

Printing Department Quality Control Standards

Feed roll damage:	
A-flute	0.002–0.003 in.
B-flute	0
C-flute	0.001–0.002 in.
Pull roll damage:	
A-flute	0.002–0.003 in.
B-flute	0
C-flute	0.001–0.002 in.
Printing impression:	
One color	
A-flute	0.010–0.015 in.
B-flute	0.005–0.008 in.
C-flute	0.008–0.010 in.
Two color (second down)	
A-flute	0.015–0.018 in.
B-flute	0.008–0.010 in.
C-flute	0.010–0.012 in.

The laboratory personnel make routine quality checks daily and, in addition, check for all other possible operating defects using a defect schedule as a guide. If anything is wrong at the time the quality checks are taken, it is brought to the attention of the press operator and foreman immediately so that spot corrections can be made.

Let us review the defect schedule.

Crooked Boxes—Possible Causes

1. Warped blanks which stick under the fingers at the gate. This is brought to the attention of the slitting or combining foremen.
2. The kicker bar is not set even at both ends.
3. The kicker bar is not set for the right width of sheet.
4. The feed rollers do not have the same tension on both ends.
5. The center pull rollers are placed too close together.
6. The center pull rollers are set incorrectly or are uneven or worn.
7. The cylinders are too high, letting the sheet slip.
8. The openings between the top and bottom slotting heads are too big.
9. The score pressure is too light.
10. Overloading the hopper.
11. The gates are set too high or too low.
12. Too much or too little tape on the kicker spring.
13. The back stop holds the sheet too tight.
14. There is too much space between the back stop and the sheet.
15. The sheets are too tight in the gages.
16. The sheets are thrown down too hard when feeding the machine.
17. The flaps are not broken on warped sheets.
18. The machine is running too fast for the sheet size.

Crushed Boxes

1. The board is too wet to print, score, or slot.
2. Warped blanks which require an excess of pressure at all high parts of the board.
3. An excess of pressure under feed rollers, pull rollers, and printing dies.
4. The edges crushed by poorly set or improperly ground trim knives.
5. Rough handling in feeding or taking off, especially when the board is wet.

Short Sheets

1. The side gages on the presses are set too wide.
2. The feeders fail to pile blanks against the proper gage on the press.
3. The trim knives are set incorrectly.

Poor Printing

1. High and low corrugations.
2. An insufficient amount or an excess of ink applied to the box blank.
3. An excess of printing crush.
4. Dirty dies, fountain, or rollers.
5. Dies which are not properly mounted on the cylinder.
6. Worn dies, rounded dies, concave dies, as well as dies which are too hard or too soft.
7. Soft board.
8. Dried ink on rollers causing poor distribution and delivery of ink to the die.
9. Fountain which is dirty and clogged.
10. Dust and dirt in the ink.
11. Ink which is not agitated in fountain.
12. Improper ink: (a) excessive tack—this pulls up paper surface fibers; (b) too long—pulls down too slow from fountain to dies; (c) too short—pulls down too fast from fountain to dies; (d) transparent or lacks strength; (e) wrong color; (f) dries too slow or too fast; (g) mottles when printed; (h) oily or dirty rollers—(1) rollers which are burned, hard, or worn; (2) no wash-up between colors; (3) dried ink fills and clogs the pores of the roller which causes blurs and bleeding at the edges of the impression (this is caused by: poor roller setting, excess ink excess impression, hard dies.)

Poor Slotting

1. The slotting heads are not centered with the scores.
2. The slotting heads are the wrong dimension.
3. The blades are set uneven across.
4. The slotting or slitting heads are crushing the sheet.
5. Unclean cut.
6. Blades which are chipped and dull.
7. Excess opening between blades and bottom slotting heads.
8. Slots are not registered to the center of the flap score or within $^1/_8$ in. over or under
9. Variable slots—this is caused by: (a) the feed hopper is loaded too heavily; (b) the sheet slips between cylinders, center pull roller, or slotting heads; (c) pressure too light on pull rollers; (d) slotting heads are too high; (e) too much or too little clearance at gates

In summarizing, we note that it is the responsibility of the laboratory to record and report all difficulties encountered when making quality checks. The foreman and press operator, in particular, must keep a critical and watchful eye at all times and follow up the recommendations made by the laboratory.

In addition, the maintenance men have to meet their obligations by carrying out all repairs and preventive maintenance measures. The plant superintendent, by coordinating and following up, sees to it that everyone concerned does his best to work out the problems which arise.

Only through the cooperation of this team of men can we insure the success of a quality and maintenance program.

Shall We Accept It?

PAUL. F. SMITH

Scott Paper Co.'s refusal throughout its history to compromise with quality has been a dominant factor in its success.

When Arthur Hoyt Scott, son of one of the founders, entered the business just prior to the turn of the century he brought with him three fundamental objectives: (1) to make just a few products of the highest quality, (2) to make them as inexpensively as possible, and (3) to tell the public about them through advertising. These three principles provided the keystone on which the Scott Paper Co. of today has been built.

The quality concept permeates every nook and cranny of our business and every employee from the top to the bottom.

For almost 30 years we have maintained in our business a consumers' representative department whose function is twofold. First, it constantly conducts surveys in homes to determine customer likes—and dislikes—in Scott brands. Results are reported directly to top management. Second, after standards based on consumer preferences are adopted, members of this department supervise the adherence to these

Paul F. Smith, Plant Materials Control Engineer, Scott Paper Co., Chester, Pa.

ndards by the manufacturing group on a day-to-day, r-to-hour basis.

t certainly stands to reason that to take the trouble, time, l money to produce the finest possible quality products and n put them in cheap, weak, or unattractive cases would be height of folly.

The materials control group with which I am associated, ong its many other duties, assumes the responsibility to that cases, such as I just mentioned, never carry Scott rchandise.

o, the constant question with which we are faced is "shall accept it?"

hall we accept it? That is the question I must answer on average of ten times each day as incoming shipments of rugated cases are checked for dimensions, compression, sting strength, and printing.

here is no doubt that printer-slotter operation is one of the st important steps in the production of corrugated cases. s in that phase of the process that the blank is made useful ough scoring and slotting and given identity and individ- ty by printing.

coring is of utmost importance since the scores determine dimensions of the case. Scott's products are toilet ues, paper towels, facial tissues, wax paper, and industrial ers. Therefore, little support is given the case by its tents. Thus, proper dimensions are absolutely necessary good packing, case sealing, shipping, and protection of the luct until it reaches the consumer. Proper scoring at the ufacturer's joint is necessary to prevent breaking at the hes, short tongue, and a weakened joint.

lotting cannot be overemphasized since accurate slotting means good case sealing and a tight container. Slotting is too deep causes holes at the corners. These openings ot be tolerated when shipping sanitary products. Shal- slotting causes binding at the flaps.

he printing of corrugated cases serves many purposes— most important of which is identification of the product in. This is a necessity to aid in trafficking the product. e most cases have sufficient area, they are usually covered printing costing a nominal amount per case. This makes case more pleasing to look at, eye catching, informative, gives it advertising value.

takes an expert printer using our modern practices of s production to produce the quality printing required by y's standards. The same is true for the production of the quality board necessary for good printing. Printing ity can be no better than the sheet being printed. How- , sloppy workmanship can readily produce poor printing good surface. Those are points well worth keeping in d.

hen inspecting printing we expect to find: (1) faithful oduction of the art, (2) excellent initial impression when ing the container, (3) correct color match, (4) good ink rage and gloss, (5) lack of smear and staple marks, (6) p definition, and (7) accurate registration.

ithful reproduction of art is vitally important to insure rmity between suppliers and compliance with legal lations. Poor reproduction may be the result of inac- te dies, improper mounting, poor mechanical condition he press, or carelessness in setting up. Occasionally, nted dies come loose during the run.

hat is the first thing you look for when you purchase a article—an automobile, piece of furniture, or even a e? Ninety-nine times out of one hundred it will be the arance or general impression of the article. Initial im- sion is extremely important. Very often it means the rence between sale or lack of sale of the item. That is reason that we demand good ink coverage and clarity or ition in the printing. The appearance of the case ts the quality of the product contained within.

lor match is very important. Have you ever looked at a stack of cases where color variations exist? If you have, I need say no more. Actually, ink color standards are not the whole answer to solving the color problem since variations in liner color can noticeably change the final ink color. For instance, light-colored liner may cause the ink to appear lighter than a darker liner.

Close inspection of any case should not reveal worn, torn, or scratched dies. Small characters should be clear and easily legible. There should be no staple marks or other extraneous printing.

One of the most important printing qualities to Scott Paper Co. is the accuracy of the printing. Accurate printing not only means good registration but to us, proper functioning of our selective eye system. This system is used to automatically remove and segregate various brands of cases from the shipping department conveyor system. Basically, the units operate in the following manner.

Each case is assigned a selective eye location or spot a specified distance from the leading edge of the case as it rides the conveyor. These marks are $1^3/_4$ in. in length and $^1/_2$ in. wide.

As the case approaches the selective eye unit, it strikes a mechanical switch that energizes an electric eye for a fraction of a second. If the electric eye "sees" an eye mark during this short time interval, the case is automatically ejected onto a spur conveyor. All other cases with different selective eye marks are allowed to pass.

It is apparent that proper registration, both top to bottom and side to side, is mandatory for the proper operation of such a system. For this reason, the eye mark locations of each lot are measured before the cases are put into production. Our specifications require registration to be within $\pm^1/_8$ in.

To aid in maintaining accurate registration, many suppliers have located a small rectangular printed block in the upper horizontal score. This helps the printer to quickly pick up register variations.

Until recently, printing evaluation at Scott consisted of checking selective eye mark locations and visually inspecting the remaining printing. We are now developing a systematic visual printing evaluation procedure in cooperation with one of our suppliers. This system has been designed so that each tested case can be compared on a numerical basis.

By multiplying the quality level for each selected category by 5, a value is obtained, and then the lowest ratings under each major division are added. The total is the quality score of that particular container. A negative 80 is used as the lowest rating in the quality level column so that if any case, representative of the lot, is unacceptable in any one category, the quality score will be a negative number.

This system does not entirely rule out the human element but it has been designed to reduce it to a minimum by using a systematic procedure. Although the system has been in use for a relatively short time, it shows promising results.

It is interesting to note that a similar procedure has proved extremely useful to the Bigelow-Sanford Carpet Co. As shown in the July, 1953, issue of *Industrial Quality Control*, this company uses a similar method as part of their inspection and quality control procedures for judging the quality of the carpets produced. They find it important not only in measuring the quality of any particular day's production but also as a yardstick in comparing the quality during one year versus another. Records have shown that in 1951 there was a decline of imperfects amounting to 18% over 1950. Since 1948, their base year, the percentage of imperfects has been cut in half. How could such a system to anything but benefit the corrugated industry?

In brief, we demand good printing on the corrugated containers we purchase to ship our products in. Such printing can only be produced by having a commercial art design, accurate dies, top grade board, a printer-slotter that is properly

set up and in good mechanical condition, and a conscientious printer that knows his job. A method to grade the work is essential so that we can compare the results and note the trends.

It is only by using the testing methods which I have outlined that we will continue to pack our ever improved quality products in ever improved shipping containers.

Discussion

Morning Session

Q. What is the best method of setting clearance between ductor and fountain roll?

A. To adjust the clearance between the ductor and fountain rolls use two thin strips of writing paper approximately 3/4 in. wide and 4 to 5 in. long, and insert them between the ductor roll and the fountain roll, one on each end. Make adjustments on the ductor roll until approximately the same tension is evident on each strip, which gives assurance that the rolls are parallel. A simple and safe rule is to bring the two rolls into contact just short of the point where force is required to rotate them. It is best to have the ductor roll come up to the fountain roll when the press is running with a brush contact, which will merely slow down the rotation of the ductor roll and not stop it abruptly.

Q. What form and ductor roll hardness is recommended?

A. Form rolls should be softer than ductor rolls, thus providing better transfer of the ink to the die. For the form rolls a durometer of 21 or 22 is about right, but the type of material used for the cover has a bearing on this. The ductor roll must be harder because it sustains more abuse in movement to and from the form roll and so a durometer of 30 may be in order. However, in all instances the roll coverer should be consulted.

Q. Some companies are now using white corrugated containers in order to improve package appearance as an advertising medium. Do you think the use of such cartons will become widespread?

A. White corrugated containers have a definite place in the industry and are particularly used in holiday seasons such as Christmas and in smaller die-cut containers.

Q. Would it be possible with steam set inks to print over the score line and score in the same operation without a one to one scorehead?

A. Offhand, I don't know whether it has been attempted. The limitation on drying of moisture-set inks probably makes the answer negative because of the tendency for excessive offset.

Q. Do you require special ink rollers for steam set inks?

A. Only rubber rollers should be used.

Q. Why don't printing machinery builders work with die makers and the corrugated industry on printing plate allowances?

A. They probably should. Leading manufacturers of printing presses adjust the diameter of printing cylinders to receive 3/8, 5/16, or 5/32 in. Without specifications from the customer, one manufacturer may produce 5/16 in. and another 9/32 in. This consideration is not as serious as it may seem because the diameter of the printing cylinder and dies frequently swells (from the use of solvents, for example) or the wooden lags become worn. Even if there were unanimity of thought concerning this there still would be considerable need for shimming.

Q. Should sponge rubber be used under printing plates to obtain better printing?

A. Sponge rubber brings up the question of shimming up the plates. If the press is made for 1/16 in. clearance there is no room for the sponge rubber. Some plates are mounted on 1/16 in. backing by the manufacturer to synchronize with the paper. Sponge rubber was formerly used more extensively than now. In cases where solid colors and small type are used on the same plate, better impressions are frequently obtained when sponge rubber is used. In some instances, sponge rubber is used as plate backing by plate manufacturers—as in halftones where there is 1/8 in. clearance. The 1/8 in. plate mounted on sponge rubber allows a more perfect "kiss" impression when printing on corrugated board. Otherwise, using sponge rubber today is just adding another problem to the operator's many problems—just confounds confusion.

Q. Do you feel that the McKinley type of self-propelled oscillating roll is helpful on heavy inks?

A. The McKinley type roll is self-propelled like a push-pull Yankee-type screw driver with right and left-hand threads. Motivation is provided from the power-driven rolls which contact the McKinley roll. This oscillating roll augments the disturbing capacity of the ink fountain. They are very helpful on heavy inks, and it is surprising that more aren't used. However, the need for these rolls will diminish with the newly developed continuously driven fountain roll because the McKinley type roll will be "beyond its depth" with the extremely viscous heavily pigmented inks now available.

Q. Why haven't better means been developed to mount dies on wooden cylinders?

A. Other means have been tried—magnetic, quickly adjustable clamps, and the window shade principle, as examples. The "window shade" principle comprises a spring-loaded roller mounted in a recession in the cylinder—upon which cloth backing is wound. There are clamps at the end of the cylinder. All that is needed is to pull out the cloth, mount the die, and then clamp down the ends. All mounting methods tried have been found to be more time consuming than the stapling method and are sensitive to dust and ink falling on them and thus building up. Stapling is fast and will withstand much operator abuse.

Q. Are special inks required for multicolor printing?

A. No. The only requisite is that the first down color have the necessary tack and color strength to allow it to be run lightly in order to properly accept the second color.

Q. How many hours can a press operate without showing enough wear to cause variation in printing and slotting?

A. There can be no satisfactory answer to this question because of the wide variation in the conception of "proper maintenance." Another variable is the degree that maintenance is subordinated to production requirements. With proper maintenance one should obtain first-class register in printing and slotting for roughly 10 years. However, the speed of the operation and the number of shifts used will affect the press life. In extreme cases, register has been maintained for 15 to 16 years. In other instances replacement is required after only 2 or 3 years. However, in the latter instance the maintenance could not have been satisfactory.

Q. If you used a fountain block without key control, how would you compensate for a condition which required heavy ink in one section and light ink in another?

A. One could introduce dams into the fountains to accomplish this, but this is the exception rather than the rule; one must sacrifice for that job the setup advantages of the improved fountain roll drive. However, it is envisioned that the cam shaft adjusting the fountain blade all the way across, will have individual key adjustments on the cams to take care of this contingency.

Q. How do you adjust form roller when using hydraulic means to raise or lower roller?

A. The hydraulic piston is only used to lift the cylinder from the die—its use is only for "motivating," not adjusting. Stops will be required to make proper adjustments.

Q. What are some of the best ways of preventing offset when printing solid jobs in gloss oil ink on corrugated boxes?

A. Printing with gloss inks is always troublesome with respect to offset if not carefully handled. It is necessary to assure oneself that the ink has sufficient strength to permit a film light enough for cover and yet give the needed gloss. Other methods involve the use of sprays which are frequently helpful. Anti-offset compounds usually have waxes and other inert materials which may be bad for succeeding layers of boxes, and should be used cautiously. Then, of course, the system of "racking" is very often used.

Q. We have found by experience that corrugated boxes printed with oil ink and subsequently packed with cans of pepper will result in the ink "bleeding" when the packed boxes are in storage: (1) What causes this bleeding? (2) What ink is recommended for cases used for packing pepper? (3) What other foods may cause bleed?

A. In such instances, the inks do not actually bleed. Gases developed upon the aging of some food products cause softening of the ink film, permitting ink transfer. By means of carefully choosing proper oils and resins the inkmaker can formulate to prevent film resoftening. When orders for printed containers for specific food products are received, call your ink manufacturer *before*, not after the boxes are printed, so that he may supply the right ink for the job.

Q. In considering half-tone printing and all other printing, what is the possibility of preweb liner printing for long runs?

A. I do not understand just what is meant by this question. In printing halftones, the preparation of the dye is important, but only one of many important factors. Equipment, condition of equipment, ink, made-ready, time, etc. are also just as important. If the question refers to the direct preprinting of liner by the gravure process, someone else should answer this question. I am not familiar with the operation.

Q. Please explain the principle of half-tone printing.

A. Half-tone print is entering the corrugated industry and this printing is accomplished by means of screens. If carried out in several colors, a color sketch is preferred and separate plates should be made. The size of the screen may be 25, 35, and up to 100. Good planning by everybody concerned—including the die, ink, and boxmaker—is needed. The coarser the screen, the more easily the dots are seen. On the other hand, a coarser screen permits easier printing and less filling. Often the artist who prepares the sketch can be very helpful if he knows the problems involved.

Q. Please discuss printing plate milage versus durometer hardness.

. Printing plate mileage is largely based upon the kind of rtenance the plate receives. Cleanliness is extremely im-tant. Mere washup with a rag and solvent is not good enough. p ink between the letters should be thoroughly brushed out veakened with solvent and blown out. Durometer softness ubber does somewhat decrease plate life.

. How does rub resistance of oil, moisture-set, and aniline compare? Is there any progress being made to improve rub stance of moisture-set inks? Is there any work being done to steam in setting moisture-set inks in the corrugated industry?

. It is possible to get good rub resistance in any of the three is with proper formulations. No one type can generally be sidered better than either of the others. It is possible with st advances to formulate moisture-set inks with good rub stance. However, there may be specific instances where it is e advantageous to use oil-based inks for maximum slip be-e of certain pigmentation characteristics. Generally, most le rely on the inherent moisture of the stock itself for setting. ubsequent operations are carried out immediately thereafter, m might be needed. The speed of drying is also influenced he relative humidity at the time of print.

Corrugated boxes travel through a press at speeds in the hborhood of 800 f.p.m. Will trapping be possible at these ds with printing cylinders 3 or 4 ft. apart?

It is quite possible provided the consistency is correct for er trapping. The principle of moisture-set inks is such they diately pick up moisture and tack to possibly enhance trap-. This, of course, is directly dependent upon the speed or.

Will hot moist corrugated board kill the gloss on a print tilizing a high gloss oil ink? If so, can ink be treated in manner to overcome this condition?

Moisture decreases gloss while heat, accelerating the dry-may help the gloss. Your ink manufacturer usually can ulate an ink to give good gloss under these conditions.

You mentioned Anilox rolls for coating only. Are foun-available now for replacement of present fountains for the uction of all aniline printed boxes, not just coated boxes?

Aniline ink fountains can be built that will do more than int the liner; they can also print the liner with dies. How-with only one aniline fountain, both operations cannot be at once with aniline, but the oil ink fountain can be used to at the same time. On the other hand, one can have a press two such fountains, one for tinting and one for printing. e fountains are not yet generally available since they have et been perfected but may be available in about 6 months. of the obvious requirements presupposes the ability to re-the present fountain for replacement with an aniline ain and this isn't always possible on all printer-slotters in nt use.

Can you tell me where I can get a drying system to operate printer-slotter delivery to immediately set a moisture-set

I am unable to answer this question at this time. We are ntly investigating the steam units being developed and d by equipment manufacturers. The home-made units I seen have not been too successful, largely because they do et the steam to the ink fast enough. The steam must get to k promptly for instantaneous drying.

What can be done to eliminate or reduce the accumulation st on printing plates when soft rubber is used and no pressure d?

The problem of dust on the printing plate is usually in-ed by the tack of the ink. If the ink is too tacky, it accumu-on the plate and doesn't want to move. If soft oil or solvent ers are used, the problem usually can be overcome.

What incompatibilities exist between flexographic inks (1) oxidation type inks, (2) moisture-set inks, and (3) when (1) or (2) is printed over the flexographic ink?

Flexographic and moisture-set inks are compatible as they similar bases. Oil base inks have a repelling effect upon raphic inks. Careful formulation of vehicles may solve the em. Thus far, most of the work in this line has been accom-d by using flexographic and moisture-set inks.

What is good mileage (square inches) for printing inks?

No real answer is possible. The mileage is influenced by ecific gravity of the ink which in turn is governed by the t of the pigments used. For example, chrome yellow will ve as good mileage as benzedrine yellow. Ink manufac-try to use pigments giving the best mileage and yet satisfy requirements.

(1) What is the type of thermoset resin in fluorescent dye (2) What percentage of emulsion types is used in aniline ng?

(1) This question cannot be answered as these formulations rrently considered confidential. (2) There has been a con-y increasing demand for emulsion-type aniline inks. g what I hope is an educated guess, I would say that the special pigment emulsions runs about 25 to 30%.

Afternoon Session

Q. What are the responsibilities of the press operator in relation to the quality program?

A. Although the operator is responsible for quality, his duties lie mainly in operation. Inspection and control by staff serves as a guide to operator.

Q. Approximately what percentage of corrugated fiberboard boxes would you say are characterized by excessive printing pressure?

A. Of 2900 groups studied, about 20% showed excess damage affecting rigidity and caliper.

Q. What parts should the customer and supplier play when developing and designing a new corrugated container?

A. Mutual education is important. Supplier should make certain the customer understands all problems and limitations in a new design.

Q. How do you feel about the specialty work which is now being run on the printer-slotters? Will this type of work continue? What about printing on white liner?

A. This business will continue and increase even though it is objectionable from a production standpoint. It appears that there will be a considerable number of orders which will require white liner.

Q. (1) Is there any relationship between high original caliper and flat crush increases in printed areas? (2) Is there any critical printing crush level where rigidity impairment sets in?

A. (1) Increases found only where original flat crush was high. (2) About 12%.

Q. What authority does the consumers' representative department have so that it can be effective?

A. It has responsibility to determine customers' needs and set specifications of Scott's products. It has the authority to decide whether a finished product is good or bad.

Q. Do you schedule sequence of orders through each printer-slotter in planning department, or is some choice left to printer-slotter foreman or operator?

A. Supervision plans the schedule with due consideration of the presses and pressmen.

Q. What, in your mind, is sufficient time for a press crew to set up a two-color register?

A. This is a difficult question. There are many variables such as the machine, operators, job, etc. However, I would say on an average 45 min.

Q. State length of time that blanks should remain on the floor to condition them before running through the press?

A. Usually, 3 to 4 hr. are required.

Q. (1) How often are rollers given caustic bath? (2) Can you give some estimate of the strength of the caustic solution? (3) How long are rollers left in bath? (4) What happens to composition rolls when they are soaked in a caustic soda bath?

A. (1) Rolls are soaked when required, perhaps at 10-day or 2-week intervals. (2, 3) About $7\frac{1}{2}\%$ caustic solution is used for a 24 to 48 hr. soak. (4) Composition rolls are not harmed.

Q. Have you any prescribed method of selecting personnel for press operators and how long is required to develop a top-rate pressman? Have you developed a training procedure?

A. We have no specific training program for the apprentice pressmen. Approximately 2 years is required to train a qualified man to be a pressman.

Q. Out of a 20,000-lot shipment of boxes, how many boxes below your standards would you say is permissible?

A. In a carload shipment (7000–9000 cases) only one compression failure is permissible out of 20 retest samples. The percentage rejected depends on the severity and type of the trouble.

Q. What would be the ratio of maintenance man-hours to running hours per press?

A. About 4 to 5%.

Q. Have you found it possible to practice preventive maintenance on printer-slotters? If so, how? What procedure do you follow?

A. Greasing is done by machine shop people, not by operators. Meetings of foremen, operators, and engineers helpful in planning and providing good maintenance.

Q. You stated that you change trim and slot blades every 8 weeks. How many shifts and days a week do your presses run?

A. Two shifts a day and 5 days a week.

Q. Briefly explain your quality control work done by laboratory personnel at printer-slotter.

A. Caliper is checked before and after passing through press. Comparison is made to set standards. A check list of other defects is followed.

Q. Will you please discuss the relationship between performance and type of paper (kraft, semichemical, etc.)?

A. When materials giving high flat crush board are used less chance of subsequent trouble and damage exists.

Q. Can you determine flat crush probability from tests made on 0.009 before combining operations?

A. Corrugating medium can be checked for potential flat crush by single flute or by concora testers.

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1953 — *Compiled by The Institute of Paper Chemistr*

The following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

July 7, 1953

2,644,282. Machine for wrapping rolls of paper and the like. Stuart Irvine. Filed Jan. 16, 1947. 8 claims. (Cl. 53-64.)

2,644,374. Paperbox covering machine. Louis Schwab. Filed Nov. 12, 1948. 3 claims. (Cl. 93-54.3.) Machine whereby a cardboard box may be covered with a paper wrapping adhesively coated all over its box engaging side.

2,644,375. Combination lining and edge finishing machine. Louis Triolo. Filed June 29, 1951. 4 claims. (Cl. 93-62.) Machine for manufacture of phonograph envelopes comprising one wall of cardboard and the other of lightweight paper.

2,644,376. Paper tube winding apparatus. Joseph H. Raymond. Filed Jan. 10, 1952. 11 claims. (Cl. 98-79.) Apparatus which makes a paper cone for dispensing confections such as cotton candy.

2,644,424. Wallpaper pasting machine. Harry A. Bixby. Filed April 28, 1950. 4 claims. (Cl. 118-246) Machine for applying paste to strips of wallpaper.

2,644,454. Sanitary towel or lady's band. Josef Karl Morhard, assignor to Vereinigte Papierwerke Schickedanz & Co. Filed Dec. 18, 1950. 1 claim. (Cl. 128-290.)

2,644,624. Bottle carrier. Reynolds Guyer, assignor to Waldorf Paper Products Co. Filed Aug. 5, 1948. 6 claims. (Cl. 224-48.) Body of the carrier is formed by a U-shaped strip of paper attached to a metal frame.

2,644,631. Disposable bottle container. Noel A. Petter, assignor to Standard Paper Box Corp. Filed April 30, 1949. 9 claims. (Cl. 229-28.) Bottle carrier.

2,644,632. Box. Clarence Lloyd Claff, assignor to Norfolk Paper Co., Inc. Filed May 1, 1947. 1 claim. (Cl. 229-34.) A windowed pocket is formed in the end of the box for holding stock cards.

2,644,633. Paperboard box construction (hexagonal). Charles A. Stopper, assignor to Diamond Paper & Box Co. Filed Jan. 8, 1949. 3 claims. (Cl. 229-37.)

2,644,634. Self-contained envelope opener and contents ejector. Geza Weitzner. Field April 22, 1950. A claim. (Cl. 229-86.) Pull string embodied in the envelope construction is attached to the article contained in the envelope.

2,644,748. Sulphite waste treatment process. George L. Cunningham, assignor to Chempatents, Inc. Filed Nov. 4, 1946. 6 claims. (Cl. 92-2.) A calcium-magnesium bisulphite liquor is employed for pulping. Calcium is precipitated from the spent liquor with magnesium and the magnesium-rich liquor concentrated and burned to recover the magnesium as an oxide.

2,644,768. Method of and means for producing simulated-brick siding boards. John E. Miller, assignor to Certain-teed Products Corp. Filed Oct. 26, 1950. 12 claims. (Cl. 117-9.)

2,644,781. Lightweight panel and method of manufacture. George Smolak and Edwin F. Dyer, assignors to Johns-Manville Corp. Filed Feb. 25, 1950. 10 claims. (Cl. 154-128.) Fireproof board is formed from felted asbestos with sheet metal veneer bonded to both sides.

2,644,810. Method of sulphurizing esters. Helen Sellei Beretvas, assignor to Standard Oil Co. Filed June 29, 1949. 20 claims. (Cl. 260-97.5.) Unsaturated aliphatic acids such as tall oil are esterified, then sulphurized at a temperature of 122 to 175 °F., neutralized, and the product dissolved in hexane.

July 14, 1953

2,645,166. Method of producing paper bags. Walter S. Blizard, assignor to Wolf Brothers, Inc. Filed Aug. 5, 1950. 2 claims. (Cl. 93-35.) Bags with rounded corners are form for the hosiery trade.

2,645,199. Paper coating machine. William A. Zonner, signor to St. Regis Paper Co. Filed May 11, 1950. 14 clai (Cl. 118-1.) "On-the-machine" coating device wherein the r are automatically moved to the inactive position by hydrau means in the event of web failure.

2,645,201. Apparatus for coating paper. Gerald D. Mugg ton, assignor to Combined Locks Paper Co. Filed April 1951. 3 claims. (Cl. 118-227.) Coating is applied to both sid of a web as it passes over a roll opposed by two other rolls. T coating is applied to one side of the web at one nip and to t other side of the web at the second nip. Weakening of the w is eliminated.

2,645,329. Mechanism for handling boards. Robert Col Blair, assignor to The British Plaster Board Ltd. Filed Dec. 1950. 9 claims. (Cl. 198-35.) Conveyor which inverts eve other sheet of plaster board and superimposes it on top of t preceding board for packaging the pair of boards face to face.

2,645,333. Hat holder for hat boxes. Paul E. Nelso Filed March 2, 1949. 11 claims. (Cl. 206-8.)

2,645,337. Carton for baked goods and other easily brok products. Richard C. Stenger, assignor to Sutherland Pap Co. Filed July 7, 1949. 4 claims. (Cl. 206-46.)

2,645,346. Paper machinery. Stephen A. Staege and Albe G. Gibson, assignors to The Black-Clawson Co. Filed May 2 1950. 9 claims. (Cl. 209-211.) A whirling motion is impart to stock which is then led directly across an enlarged chamber the discharge tube. Dirt is thrown out in the chamber by ce trifugal force and the clean stock continues out the discharge tub

2,645,347. Vortex separator for pulp. Joseph Baxter, J assignor to The Black-Clawson Co. Filed May 20, 1950. claims. (Cl. 209-211.) Stock is carried to the bottom of t settling chamber in the inlet tube, deflected upward in a helic path which surrounds the inlet tube, and the clean stock is c lected at the top of the settling chamber in an annular space.

2,645,350. Flotation apparatus. Sven Gösta Nordstr assignor to Ingeniorsfirman Fliesberg Aktiebolag. Filed Ap 13, 1948. 4 claims. (Cl. 210-53.) Nozzle formed by two di having parallel faces with liquid inlet at the center of the di Material to be separated by flotation is introduced into the ta through this nozzle.

2,645,378. Pulp storage tower and method of emptying sam Johan Christoffer Fredrick Carl Richter, assignor to Aktiebolag Kamyr. Filed March 5, 1948. 14 claims. (Cl. 222-1.) Pu at 15 to 20% consistency is removed from a vertical storage tow by introducing water at the bottom of the tower and carrying th pulp upward by flotation. A conveyor carries away the pu from the top of the tower.

2,645,402. Collapsible cellular carton. Kenneth T. Butter assignor to Sutherland Paper Co. Filed Feb. 12, 1951. 3 claim (Cl. 229-28.) Paperboard egg carton which may be separate into two cartons containing six eggs each.

2,645,403. Bottle carrier. Edwin L. Arneson, assignor Morris Paper Mills. Filed Jan. 15, 1947. 5 claims. (Cl. 229-28

2,645, 404. Collapsible covered container. Kenneth T. Bu tery assignor to Sutherland Paper Co. Filed Nov. 21, 1949. claims. (Cl. 229-36.)

2,645,405. Collapsible and reusable carton. Irving Dorfma assignor to Federal Carton Corp. Filed May 6, 1950. 1 clai (Cl. 229-38.)

2,645,406. Box. Irving Robins, assignor to Add-A-Hand Carton Co. Filed Feb. 6, 1948. 2 claims. (Cl. 229-52.) detachable handle is attached through slots in the ends of the bo

2,645,407. Box with carrying handle. Robert M. Bergstei Filed Sept. 1, 1948. 5 claims. (Cl. 229-52.)

2,645,408. Attachable and detachable handle closure co bination. Harry L. Eckles. Filed Aug. 8, 1949. 1 claim. (C 229-52.) This device frictionally engages the folded closu flaps so that the weight of the container and its contents will i crease the grip of the handle.

2,645,479. Multiple sheet feeder. William E. Mitche Filed Aug. 25, 1950. 3 claims. (Cl. 271-27.) Sheet feeder pa ticularly adapted for feeding two or more sheets in superimpos relationship.

2,645,480. Sheet delivery system for presses. Henry

ng. Filed May 22, 1952. 10 claims. (Cl. 271-74.) Simul-neous air blasts and vacuum in sheet delivery zone forces sheets settle rapidly onto the stack.

2,645,481. Novelty greeting card. Alvin Barker. Filed b. 28, 1949. 5 claims. (Cl. 272-27.)

2,645, 576. Purifying wood pulp. Stanley Charles Bate, signor to Celanese Corp. of America. Filed Feb. 11, 1949. 2 ims. (Cl. 92-13.) Alkali treatment of pulps containing about % alpha-cellulose with 17 to 19% alkali at 40 to 60 °C. results pulp suitable for esterification and containing 92 to 95% alpha-lulose.

2,645,577. Purifying wood pulp. Stanley Charles Bate, ancis George Peach, and Walter Alan Rogerson, assignors to itish Celanese Ltd. Filed April 9, 1950. 4 claims. (Cl. 13.) Essentially the same as U. S. patent 2,645,576 except t a boil with water is added after, or as a part of, the wash de-ibed in the previous patent.

2,645,587. Method of making lignocellulose pressure molded icle. Robert V. Williamson, assignor to the United States of erica as represented by the Secretary of Agriculture. Filed y 25, 1950. 6 claims. (Cl. 106-200.) Materials such as shells, straw, rice hulls, corncobs, and the like are heated in finely divided state to increase the degree of water resistance effect a saving in the amount of resin binder required to form ded products.

2,645,617. Paper pulp foam inhibitor. Raymond L. May- and James M. Cross, assignors to General Aniline & Film p. Filed Nov. 6, 1948. 8 claims. (Cl. 252-321.) An lsion formed from an alkyd resin, palmitic acid, water, and um hydroxide solution reduces foam and does not have a det-ental effect on sizing.

2,645,633. Process for extraction of lignin. James H. Rich-d, Robert M. Boehm, and Harold Roy Hunt, assignors to sonite Corp. Filed Nov. 14, 1949. 5 claims. (Cl. 260-124.) ely divided material from woods, bamboo, straw, cornstalks, ses, and the like is washed with hot formic acid-water azeo-e to extract the lignin, the azeotrope distilled off, the lignin olved in methyl cellosolve and precipitated into water.

July 21, 1953

2,646,092. Log debarking machine having whirling and rotat-bark-removing tools. Olof R. Kolpe and Oscar B. Andersson. d Aug. 29, 1949. 3 claims. (Cl. 144-208.) Log debarker h comprises an outer rotatable drum and small bark-remov-drums equipped with spring-loaded pins which abrade bark the logs. Rotation of the outer drum causes the small ns to rotate.

2,646,132. Electrical precipitator for gas separation. Charles eaver, assignor to Research Corp. Filed Jan. 9, 1951. 5 ns. (Cl. 183-7.) An electrical precipitator for use in con-tion with a sulphate process recovery system contains a black r sump into which the precipitated ash falls and is dissolved. age of the hot gases over a disk concentrator before entering precipitator tends to cool the gas and concentrate the liquor e sump.

2,646,165. Packaging means. Earl B. Whitehead, assignor to ntic Carton Corp. Filed Nov. 30, 1951. 1 claim. (Cl. 56.) A carton with spacing inserts for holding fragile articles Thermos bottle filler) out of contact with the carton walls.

2,646,166. Carton for yarn packages. Fred. W. Paffen and rd M. Engel, assignor to Celanese Corp. of America. Filed 25, 1949. 2 claims. (Cl. 206-65.) Horizontal separators provided with fittings that engage the top and bottom of for packaging yarn.

2,646,169. Process and apparatus for the separation of mate-of different specific gravity and sizes. Willem C. Fox and N. J. Leeman, assignors to Stamicarbon N. V. Filed Oct. 948. 8 claims. (Cl. 209-173.) Fluid inlet is at the apex is inverted conical vessel with overflow weir at the top. An ontroller in the zone of separation is employed to adjust the of fluid inlet at the apex, and thus the specific gravity in the ation zone.

2,646,195. Apparel holder for coat hangers. Dudley C. t. Filed Aug. 27, 1949. 5 claims. (Cl. 223-88.) Holder eckties, dress belts, etc. attached to wire clothes hanger.

2,646,200. Drinking vessel. Samuel Lawrence Atkins. Filed 6, 1945. 1 claim. (Cl. 229-7.) Paper drinking cup having near the top edge and a foldable spout adhesively attached e outside of the cup.

2,646,201. Container with insert. John W. Meinhardt, as-r to Gaylord Container Corp. Filed July 8, 1952. 6 claims. 229-15.) Insert forms a shelf for separation of items such kery goods.

2,646,202. Flap locking device for container inserts. Clyde bbons, assignor to Gaylord Container Corp. Filed Oct. 49. 2 claims. (Cl. 229-40.) Tubular carton inserts are n shape by locking tabs which engage the adjacent layer of when bent at right angles.

2,646,203. Bag. Charles V. Brady and Russell J. Williams, assignors to Bemis Bros. Bag Co. Filed June 9, 1949. 2 claims. (Cl. 229-53.) A lower section of paper is adhesively joined to an upper section of woven, perforated material.

2,646,357. Package. Oscar E. Seiferth, assignor to Oscar Mayer & Co., Inc. Filed April 12, 1950. 14 claims. (Cl. 99-174.) Package for link sausage.

2,646,362. Paraffin wax composition. Robert G. Capell, William P. Ridenour, and John A. Stewart, assignors to Gulf Research & Development Co. Filed June 30, 1950. 6 claims. (Cl. 106-270.) Oxidation of paraffin wax upon heating can be inhibited by the addition of small amounts of hydroquinone monobenzyl ether.

2,646,363. Sealing composition for transparentized paper. Robert R. Parmentier. Filed April 12, 1950. 3 claims. (Cl. 106-271.) This is very similar to U. S. patent 2,646,369 (July 21, 1953).

2,646,365. Backing paper for roll photographic film. Ernest L. Baxter, assignor to Eastman Kodak Co. Filed Sept. 27, 1950. 2 claims. (Cl. 117-14.) Kraft paper coated with zein containing carbon black and other materials provides an opaque backing paper for photographic roll film.

2,646,366. Backing paper for roll photographic film. Ernest L. Baxter, assignor to Eastman Kodak Co. Filed Dec. 8, 1951. 2 claims. (Cl. 117-14.) This is very similar to U. S. patent 2,646,365.

2,646,367. Transfer paper. Chester Davis and Ned A. Thacker, assignors to The National Cash Register Co. Filed June 28, 1951. 2 claims. (Cl. 117-36.) Wax coating containing an oil which carries a colorless color-reactant material is applied to the underside of this manifold sheet. A sensitized receiving sheet having a suitable coating is likewise colorless until acted upon by the color reactant in the oil.

2,646,369. Process of transparentizing paper. Robert R. Parmentier. Filed April 12, 1950. 8 claims. (Cl. 117-92.) Paper is treated with a composition containing refined mineral oil, toluene, and carbon tetrachloride, then before this has dried a sealing composition containing petroleum wax, gasoline hydrocarbon fraction, and carbon tetrachloride is applied to transparentize the paper. Prints may be reproduced directly from paper so treated.

2,646,373. Treatment of papermaking fibers with organosilicon compounds. Clinton W. MacMullen, Richard C. Shaver, and Robert L. Titus, assignors to Cowles Chemical Co. Filed Jan. 20, 1950. 5 claims. (Cl. 117-155.) Improved wet strength and water resistance is displayed by paper wherein an organosilicon compound is added in alkaline solution to the acidified pulp. Curing is accomplished in the slurry form at room temperature and by heating the finished paper.

2,646,381. Method for dispersing and felting fibers and mill. Thure C. Duvall, assignor to Wood Conversion Co. Filed Dec. 1, 1949. 12 claims. (Cl. 154-101.) Nozzle-bearing dispersion mill for discharging an air-suspension of substantially individualized fibers which are felted on an endless conveyor in a deposition chamber.

2,645,937. Method of testing sheet materials. Marvin F. Skalmusky, Carleton H. Root, and Robert C. McKee, assignor to The Institute of Paper Chemistry. Filed Oct. 28, 1949. 1 claim. (Cl. 73-94.) Corrugating medium to be tested is pressed between matched dies to impart a flute shape, then fluted sample is clamped in holder and subjected to pressure to point of failure.

2,645,982. Apparatus for treating paper stock. Edwin Cowles, assignor to The Cowles Co. Filed Nov. 14, 1949. 6 claims. (Cl. 92-26.) Rotor blades and stator blades are stacked alternately with spacing rings between so that a fixed clearance is maintained in this device for preparing slush stock. These blades are spaced about $^1/_{64}$ of an inch apart so that fiber bundles and agglomerated particles of stock are subjected to vigorous mechanical action in passing through the apparatus.

2,645,983. Conical plug refiner. Cyrus E. Roberson, assignor to The Noble & Wood Machine Co. Filed Feb. 15, 1949. 9 claims. (Cl. 92-27.) Large shell head is adjustable so that as the plug is advanced to compensate for wear of the cutter bars, the shell head is moved inward to maintain constant conditions within the refiner.

2,645,984. Boxmaking machine. William F. Linstedt, assignor to Kraft Foods Co. Filed Aug. 22, 1946. 7 claims. (Cl. 93-39.) Paperboard strip is formed into a tubular section and inserted in a tray erected from the collapsed position.

July 28, 1953

2,647,048. Composition for stiffening paper match splints. Herbert Ellern, assignor to Universal Match Corp. Filed March 7, 1947. 1 claim. (Cl. 52-26.) Impregnation of the splint with white refined paraffin, limed rosin gilsonite, and a substituted polyamid of stearic acid is claimed to substantially increase breaking strength.

2,647,069. Manufacture of silicate-coated papers. William

Stericker, assignor to Philadelphia Quartz Co. Filed Jan. 23, 1947. 2 claims. (Cl. 117-152.) Impregnation of paper or paperboard with sodium silicate solution containing peroxide imparts grease and oil resistance and simultaneously provides some bleaching of the fiber.

2,647,114. Method for making readily filterable viscose. Erich Torke and Werner Matthaes, assignor to Phrix-Werke, A. G. Filed Dec. 2, 1950. 8 claims. (Cl. 260-217.) Alkali cellulose is treated with carbon disulphide and a caustic solution is added as a diluent during the sulphiding process.

2,646,717. Device for the identification of documents or printed matter. Paul J. Selgin. Filed Sept. 20, 1950. 5 claims. (Cl. 88-14.) A scanning device compares an authentic document with a reproduction and emits one signal for a true document and a different signal for a false document.

2,646,877. Package for tapelike material. William M. Scholl. Filed Nov. 30, 1949. 3 claims. (Cl. 206-52.) Hermetically sealed package for surgical gauze comprises a paper leader attached to the end of the tape and sealed at point of passage through the package wall. Pulling on the leader fractures the seal and unwinds the gauze.

2,646,876. Mailable display package. George C. Sparks. Filed Sept. 7, 1951. 6 claims. (Cl. 206-46.) Mailing package with heavy cardboard core cutout for positioning the enclosed article.

2,646,914. Reinforced tray. Chester E. Claff and Carl A. Moeller, assignors to Norfolk Paper Co., Inc. Filed June 6, 1947. 2 claims. (Cl. 229-32.) Shoe box cover is reinforced by the insertion of a cord in the edge of the blank.

2,646,915. Folding box. Arthur Bockmann. Filed March 6, 1948. 8 claims. (Cl. 229-34.) Folding box with inwardly sloping sides to form an ash tray, etc.

2,646,916. Corner construction for folding boxes. Reginald B. Meller, assignor to Bemiss-Jason Co. Filed Nov. 30, 1949. 9 claims. (Cl. 229-35.) The locking tongue and slot construction is claimed to be adaptable to setup by completely automatic machinery.

2,646,917. Carton and closure therefor. George W. Smith. Filed Feb. 2, 1949. 2 claims. (Cl. 229-37.) Carton comprises a tubular section whose end flaps are folded and the triangular end formed is tucked back into Y-shaped slits in the side walls.

2,646,918. Bottle carrier. Homer W. Forrer, assignor to Atlanta Paper Co. Filed Sept. 30, 1949. 4 claims. (Cl. 229-41.) Paperboard bottle carrier may be collapsed for storage.

2,646,983. Feeder for carton blanks. Edward J. Pagendarm, assignor to Bemiss-Jason Co. Filed Jan. 28, 1947. 5 claims. (Cl. 271-36.) Preformed blanks are fed by engagement with a feed wheel into a carton forming machine.

August 4, 1953

2,647,444. Paper pulp beating engine. Edouard Héry and Kristen A. Thorsen. Filed May 25, 1948. 3 claims. (Cl. 92-22.) Beater unit contains a pulp reservoir with ports positioned to deliver pulp between roll and bedplate.

2,647,445. Beater refiner apparatus. Dwight E. Jones and Charles H. Vickery, assignors to E. D. Jones & Sons Co. Filed Dec. 2, 1950. 5 claims. (Cl. 92-24.) Self-contained beating unit of welded plate construction contains bedplate, roll supports, backfall, etc., upon a single baseplate.

2,647,446. Waste stripping mechanism for carton blank forming apparatus. Gideon Kane. Filed Feb. 28, 1951. 2 claims. (Cl. 93-36.) Carton blanks from the blanking press are stripped of waste by impaling the waste portions on pins projecting from a wooden roll, then removing the waste from the pins by means of slotted fingers.

2,647,447. Flap folding means. Noble André. Filed Feb. 28, 1948. 3 claims. (Cl. 93-49.) Flaps of folding boxes are engaged by spring fingers and folded rearward as the carton blank advances.

2,647,548. Short wood chain barker. Herbert W. Guettler. Filed Oct. 8, 1949. 7 claims. (Cl. 144-208.) An attritional barker in which logs are carried to the top of the pile in a vat and allowed to tumble downward over the other logs in the vat.

2,647,576. Production of short paper rolls from long paper rolls. Nicholas Marcalus. Filed Feb. 16, 1949. 15 claims. (Cl. 164-35.) Paper is rewound to desired diameter on a core, then rolls of the desired length cut from the roll by a band knife.

2,647,678. Holder for paper plates and the like. Douglas J. Olson. Filed May 5, 1950. 1 claim. (Cl. 229-1.5.) This holder is attached to the bottom of a paper plate and may be bent downward for gripping between the knees of a user.

2,647,679. Cellular case. Paul A. Schilling, Thomas G. Mairs, and John B. Baird, assignors to Waldorf Paper Products Co. Filed Nov. 28, 1949. 4 claims. (Cl. 229-15.) Cellular case for 24 bottles with paperboard walls, bottom, and partitions is sufficiently strong for reuse.

2,647,680. Bag assembly. Clarence W. Vogt. Filed July 13, 1948. 9 claims. (Cl. 229-53.) Method of handling bags during successive operations wherein the bags are connected by heat-activated adhesive to a strip or strips of paper which a to advance the bag from station to station and assist in openi closing, sealing, etc.

2,647,681. Seasoning dispenser. Stephen Arthur Pa Filed April 20, 1949. 4 claims. (Cl. 229-56.) A capsule co taining condiments such as salt to be fastened on the interior bags containing potato chips or the like, the quantity of cond ment applied to the contents is selectable by the user.

2,647,816. Method of making a wound package and afte treating the same. Orlando A. Battista, assignor to Americ Viscose Corp. Filed July 10, 1948. 4 claims. (Cl. 8-155.2 Cellulose ester fibers are bonded to a liquid-permeable base a the paper used to wrap rayon cakes during processing. Shrin age of the fibers on the paper causes the wrapper to adhere close during subsequent processing.

2,647,842. Apparatus and process for coating paper. R dolph N. Griesheimer and Robert C. Hydell, assignors to T Mead Corp. Filed Jan. 31, 1948. 14 claims. (Cl. 117-6 A refrigerated roll is employed in this coating device to smoo the coating immediately after application. Temperatures the order of −20 to −40°C. nullify the adhesive properties the coating for the roll.

2,647,888. Plastic tall oil rosin fraction. Don E. Floy assignor to General Mills, Inc. Filed Nov. 19, 1949. 6 claim (Cl. 260-97.5.) Products suitable for varnishes, resins, and t like are produced by esterification of tall oil rosin acid fracti with an excess of polyhydric alcohol.

August 11, 1953

2,648,180. Wrapping machine. Thomas B. Dalton, assign to Valley Research Corp. Filed May 27, 1948. 5 claims. (C 53-32.) Butter, frozen foods, etc., are wrapped with a prec sheet of wrapping material having a heat-sealable coating of wa Sealing elements make a seal at the overlapped edges of t wrapping

2,648,183. Wrapper feeding mechanism. Thomas B. Dalto assignor to Valley Research Corp. Filed Oct. 17, 1949. claims. (Cl. 53-155.) Light-sensitive element such as a phot tube is registered on index marks of wrapping paper web, thereb insuring the cutting of the material into predetermined lengths.

2,648,251. Fiber length distribution measuring instrumen Louis M. Puster, assignor to The University of Tennessee R search Corp. Filed July 2, 1947. 6 claims. (Cl. 88-14) Tra mittal of light from a single source through known and unknow textile fiber samples is measured by a pair of photocells. Unba ance between the photocells is detected by a galvanometer whi actuates a tracing pen for tracing a fiber length distribution cur

2,648,261. Fiber disintegrator and separator. Merle Chaplin, assignor to Chaplin Corp. Filed June 30, 1950. claims. (Cl. 92-23.) Pulper for waste paper, etc., wherein t defibered material is continuously removed from the tank t screens mounted in the wall. A vibrating diaphragm is locat on the outside of the screen to aid in the removal of fibers.

2,648,262. Fibrous material extrusion apparatus. Edwa L. Croston and Horace R. Harbord, assignors to American Ma ufacturing Co., Inc. Filed Sept. 3, 1948. 9 claims. (C 92-61.) Continuous process hardboard machine wherein the ma is compressed in a tapered extrusion chamber, then dried an cured between heated platens which are a continuation of t extrusion chamber.

2,648,263. Method of making bags. Arthur W. Riche Filed Oct. 2, 1948. 4 claims. (Cl. 93-35.) Method and ma chine for making square bottom bags from bag tubing lined wit moisture-resistant coating. Thermoplastic adhesive is used t make a sealed closure resistant to seepage of liquids or pulver lent materials.

2,648,371. Method and machine for producing a continuou honeycomb structure. George I. Goodwin and Howard Klee. (Klee's interest assigned to Goodwin.) Filed Marc 27, 1948. 26 claims. (Cl. 154-1.8.) Method and machine fo forming a honeycomb cellular structure from strips of paper, t structure made rigid by application of thermosetting resin, t resin cured, and the structure incorporated in a building pane door, etc.

2,648,427. Display carton. Cary J. Langford, assignor t Waldorf Paper Products Co. Filed Nov. 4, 1949. 1 claim (Cl. 206-45.31.) Overwrapped tray for packaging fruits and veg tables with score marks in the bottom of the tray to provide hinged opening to the carton.

2,648,429. Dispenser. William C. Smith, assignor to Chicag Carton Co. Filed Dec. 29, 1949. 4 claims. (Cl. 206-56. Dispensing container for ice cream cones has a double botto with aligned openings wherein tabs in the upper opening begin t support the stack of cones while lowest cone is being withdraw

2,648,469. Shirt board. Knowles Youngblood. Filed Apr 10, 1950. 1 claim. (Cl. 223-71.)

2,648,470. Collar support. Ceasar A. Calder. Filed De 23, 1948. 18 claims. (Cl. 223-83.)

2,648,480. Easy packing deep container. Samuel P. Belsinr, assignor to Belsinger, Inc. Filed July 12, 1948. 1 claim. l. 229-7.) Front panel folds down to allow access to the botm of the container.

2,648,481. Heavy duty fiber container. Samuel P. Belsinger, signor to Belsinger, Inc. Filed March 1, 1950. 1 claim. (Cl. 9-27.) Heavy duty shipping container for eggs and the like s double front and rear walls and a double central partition.

2,648,482. Heavy duty fiber container. Samuel P. Belsinger, signor to Belsinger, Inc. Filed March 1, 1950. 1 claim. l. 229-27.) Similar to U.S. patent 2,648,482 (Aug. 11, 1953).

2,648,483. Heavy duty fiber container. Samuel P. Belsin-, assignor to Belsinger, Inc. Filed Nov. 9, 1951. 1 claim. l. 229-27.) Double walled container with separate cover flaps.

2,648,484. Heavy duty fiber container. Jack Russell Belsin-, assignor to Belsinger, Inc. Filed Feb. 19, 1951. 3 claims. l. 229-36.) Heavy duty fiberboard container with locking s and slots for assembly of the container so that other fastening ans is unnecessary.

2,648,485. Cardboard box spring hinge. Lewis D. Young, ignor to Douglas Young, Inc. Filed Jan. 6, 1951. 2 claims. . 229-44.) Very similar to U.S. patent 2,648,486 (Aug. 11, 3).

2,648,486. Cardboard box. Lewis D. Young, assignor to uglas Young, Inc. Filed March 23, 1953. 4 claims. (Cl. -44.) Piano-type hinge of lightweight sheet metal attached aperboard box.

2,648,487. Bag for packaging tacky polymeric materials. nk R. Linda, assignor to St. Regis Paper Co. Filed July 1947. 10 claims. (Cl. 229-55.) A fracture layer such as melting point wax or oil-saturated clay is used between the ystyrene or polyethylene coating which adheres to the filling terial.

2,648,543. Laminated ski. Edward W. Grabowski. Filed . 30, 1949. 2 claims. (Cl. 280-11.13.) A ski of box conction whose upper and lower sides are formed of laminated er or fabric bonded with a waterproof resin.

2,648,614. Pressure sensitive adhesive sheet material. John Martin and Chester S. Funk, assignors to Crown Zellerbach p. Filed Oct. 27, 1950. 11 claims. (Cl. 117-68.5.) Release ting for the reverse side of pressure sensitive tape made from t paper and the like, the coating comprising a combination romium stearato chloride and hydroxyethyl cellulose.

2,648,615. Method of flameproofing cellulosic wallboard and le produced thereby. Harold C. O'Brien, Jr. Filed May 1949. 14 claims. (Cl. 117-71.) Cellulosic wallboard is ered flameproof by soaking in a hot aqueous solution of monium sulfamate, sodium tetraborate, and a suitable wetting t.

2,648,617. Filter medium and method of making the same. man D. Hanson, assignor to Union Carbide and Carbon Corp. Sept. 2, 1948. 8 claims. (Cl. 117-155.) An ester resulting the condensation of a polyhydric alcohol with a dienoic oacid is useful for impregnation of filter papers in contact water.

2,648,620. Sticking together resin-impregnated cellulosic s. Edward S. Hole. Filed Jan. 5, 1951. 10 claims. 154-138.) Laminating composition consists of aluminum oxide, chalk powder, magnesium chromate, and water which plied to the dry sheets and the pack pressed to form printing s and matrices of the required thickness.

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2,648,954. Refrigerated carton. Gordon D. Wheeler and s H. Reilly. Filed Sept. 7, 1950. 5 claims. (Cl. 62-91.5.) ified carbon dioxide or containers for the same are supported e partition between cans.

2,649,034. Pulp wood product and method of manufacturing. nce U. Gramelspacher. Filed Sept. 17, 1949. 3 claims. 2-40.) Hardboard product in which wood chips, sawdust, minimum of 5% of wood pulp fiber are mixed together in an ous medium, formed on a wire, dried, treated with binder, edried to set the binder.

2,649,035. Apparatus for making stiffened wrappers. Wil-S. Cloud. Filed April 5, 1951. 15 claims. (Cl. 93-1.) ine for insertion of stiffening strip inside of tubular candy pers.

2,649,135. Process for the production of insulating panels, panels, furniture board, or the like. Werener Prase. Filed 28, 1950. 7 claims. (Cl. 154-28.) Panels with faces of veneer, plywood, or compressed sheets are filled with glass slag wool, or rock wool to make panels for doors, insulating s, furniture board, and the like.

2,649,154. Hydraulically operated paper cutter. Joseph n, assignor to Super Speed Printing Machinery, Inc. Filed 26, 1950. 8 claims. (Cl. 164-56.) Knife control mechainsures that the knife is raised to the upper limit of travel stopping.

2,649,155. Sheet handling mechanism for cutting machines. William R. Spiller, assignor to Harris-Seybold Co. Filed Feb. 24, 1947. 37 claims. (Cl. 164-59.) A control means for control of the back gage on a sheet cutter work table. Forward and backward movement of the gage is controlled by a series of rods in the turret head with either automatic response to the cutting knife or manual actuation.

2,649,195. Single blank carton with display card cover. Harry J. Rossi and Arthur J. Weiss, assignors to Robert Gair Co., Inc. Filed April 6, 1950. 2 claims. (Cl. 206-45.29.)

2,649,197. Container package structure. William Jameson. Filed June 23, 1951. 3 claims. (Cl. 206-47.) Nested paper cups containing a water-soluble material for a drink are sealed with wax to the body of the nested container.

2,649,228. Shirt packaging device. William W. McFall. Filed April 19, 1951. 4 claims. (Cl. 223-71.) A portion of the panel folds over the collar and is supported by a strut device to protect the collar.

2,649,229. Garment hanger. Gladys Sutter. Filed Jan. 2, 1951. 12 claims. (Cl. 223-98.) Rounded shoulder supports of stiff paper or cardboard, used in conjunction with a wire or wood garment hanger provides support for the shoulders of the garment.

2,649,238. Consumer type container. Lewis C. Brooks, assignor of one third to Ira Milton Jones. Filed Feb. 17, 1950. 2 claims. (Cl. 229-23.) Container with flaps on the unattached edges of the cover member, these flaps engaging in a groove in the upper edge of the carton body. The cover may be reclosed as often as necessary.

2,649,239. Sealed container. Ransom C. Ellsworth, assignor to The Ohio Boxboard Co. Filed May 8, 1950. 1 claim. (Cl. 229-33.) Hinged cover member is sealed by spot gluing to flaps.

2,649,240. Blank for box production. Clyde L. Gilbert. Filed Oct. 13, 1947. 2 claims. (Cl. 229-39.)

2,649,371. Apparatus for deinking and defibering wastepaper. Charles S. Reid. Filed May 3, 1949. 4 claims. (Cl. 92-1.2.) Horizontal cylinder with mesh bottom on lower half contains a central shaft with arms to mix and defiber wastepaper. Liquids and ink solids are removed continuously through the wire mesh bottom.

2,649,372. Method of making sheet material. Leander H. Hills, assignor to The Garlock Packing Co. Filed Jan. 6, 1950. 6 claims. (Cl. 92-21.) Flexible fibrous sheet for gasketing, etc. is formed by addition of chromate or dichromate to pulp, forming the web, then saturating the web with a mixture of animal glue, glycerine, and water.

2,649,373. Paper printing foils for lithographic purposes and a process of preparing them. Wilhelm Neugebauer, Jakob Barthenheier, and August Rebenstock, assignors to S. D. Warren Co. Filed Oct. 18, 1948. 10 claims. (Cl. 95-6.) Photolithographic printing plates comprising paper photosensitized by diazo compounds.

2,649,385. Optically bleached fibrous material. John David Kendall and Douglas James Fry, assignors to Illford Ltd. Filed Oct. 15, 1951. 13 claims. (Cl. 117-33.5.) Optical brightening agent.

2,649,386. Coated paper and method for making same. Paul A. Snowman, Jr., assignor to North American Paper Process Co. Filed Feb. 21, 1948. 5 claims. (Cl. 117-38.) Coating method wherein the coating is applied as a pattern of minute mounds of coating separated by uncoated areas. Calendering the coated sheet forces the mounds into the web at the same time that the surface is leveled.

2,649,394. Air-laying fiber felts. Allen M. Crewson, assignor to Wood Conversion Co. Filed June 29, 1951. 4 claims. (Cl. 154-101.) Triethanolamine oleate introduced as a mist into the deposition chamber for air-laying fibrous mat material reduces the formation of festoons within the chamber.

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2,649,957. Combined container and display rack. Joseph M. Gapstur. Filed Nov. 14, 1949. 1 claim. (Cl. 206-45.14.) Container which may be formed into a display rack for small articles.

2,649,912. Back gage for paper cutterdrive disconnect for manual operation. Sydney Frankel, assignor to E. P. Lawson Co. Filed March 25, 1950. 2 claims. (Cl. 164-59.) Means is provided for disconnecting the back gage from hydraulic drive for manual operation.

2,649,910. Drive mechanism for guillotine knife bars. Frederick W. Seybold, assignor to E. P. Lawson Co. Filed Aug. 20, 1948. 5 claims. (Cl. 164-54.) Clamping means and the cutter knive in this mechanism are interconnected to ensure that the stack is firmly clamped before the knife is actuated.

2,649,859. Disposable diaper. William A. Hermanson and Gerald I. Hermanson. Filed Feb. 10, 1951. 10 claims. (Cl. 128-287.) Disposable diaper composed of a permeable top sheet, an absorbent layer, and a plastic film backing sheet.

2,649,858. Disposable baby diaper. John M. Le Bolt, assignor to The Cromwell Paper Co. Filed Jan. 9, 1951. 5 claims. (Cl. 128-284.) Disposable diaper provided with a pressure-sealable adhesive on the band for joining the front and rear panels.

2,649,807. Plant shipping container. Alexander S. Ritter. Filed Nov. 28, 1950. 2 claims. (Cl. 47-37.) Container for shipment and display of plotted plants.

2,649,719. Suction roll seal assembly. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed April 27, 1949. 7 claims. (Cl. 92-53.) Sealing device for suction rolls wherein the sealing strip is held in engagement with the inside of the roll by pressure from an inflated rubber tube contained in the slot beneath the seal strip.

2,649,718. Rotary refiner. Edmund P. Arpin, Jr. Filed Nov. 7, 1952. 3 claims. (Cl. 92-26.) Similar to U. S. patent 2,649,717 (Aug. 25, 1953).

2,649,717. Rotary refiner. Edmund P. Arpin, Jr., and Raymond P. Frye. (Frye's interest assigned to Arpin.) Filed Aug. 28, 1951. 4 claims. (Cl. 92-26.) This refiner comprises an abrasive cylindrical liner within which a shaft containing refiner elements is rotated. Rotation of the shaft forces the elements against the abrasive liner; clearance of the elements is controlled through the hollow shaft.

2,649,676. Apparatus for handling cartons. Charles E. Kerr and Roscoe Elsheimer, assignors to Food Machinery and Chemical Corp. Filed July 8, 1946. 17 claims. (Cl. 53-138.) Machine erects flange collapsed on the under side of the carton cover, then closes the cover.

2,649,674. Packaging machine. Harold L. Bartelt, assignor of 45% to Donald E. Bartelt. Filed June 13, 1949. 16 claims. (Cl. 53-89.) Bags are formed from a strip of heat-sealable film material, filled and severed from the web. The machine features adjustability of bag size.

2,649,673. Packaging machine. Harold L. Bartelt, assignor of 45% to Donald E. Bartelt. Filed April 23, 1952. 5 claims. (Cl. 53-86.) Machine for forming a pair of bags from heat-sealable material and filling the bags at separate stations, then severing from the web.

2,650,002. Apparatus from feeding fibrous material. Philip Sidney Farley, assignor to Noble Co. Filed July 27, 1948. 1 claim. (Cl. 222-238.) An agitator is mounted above a screw conveyor for removal of scrap asbestos from a storage bin.

2,650,006. Garment hanger. Carl N. Bergstrom, assignor to Waldorf Paper Products Co. Filed Nov. 4, 1948. 8 claims. (Cl. 223-88.)

2,650,015. Carton. William P. Frankenstein. Filed Jan. 2, 1948. 9 claims. (Cl. 229-31.) Carton shipped in flat condition and assembled by user for shipment or display.

2,650,016. Parcel bag. Harold I. McMillan, assignor to Cohoes Envelope Co., Inc. Filed March 31, 1949. 3 claims. (Cl. 229-55.) Reinforcing panel of heavy paper or cardboard strengthens the bottom of paper bags.

2,650,038. Automatic web rewinding machine. Jasper Kievit, assignor to The Crystal Waxing Co. Filed March 29, 1947. 4 claims. (Cl. 242-56.) Rewinder for small rolls of waxed paper of measured length contains two mandrels which are alternately filled and discharged.

2,650,039. Rewinding machine. Thomas N. Carter, assignor to Cameron Machine Co. Filed Nov. 28, 1950. 4 claims. (Cl. 242-65.) Rewinding machine wherein the surface speed of the rewind roll is maintained constant as the diameter increases.

2,650,093. Blank feeding mechanism. Albert F. Shields, assignor to S & S Corrugated Paper Machinery Co., Inc. Filed March 3, 1949. 3 claims. (Cl. 271-44.) Blank feeding mechanism employs a chain mounted between crank arms for moving the blank any desired distance.

2,650,109. Apparatus for aligning and sorting sheets of paper, etc., and parts therefor. Claude W. Johnson. Filed Dec. 9, 1949. 30 claims. (Cl. 282-1.) Apparatus for aligning and sorting cards for a punched card system.

2,650,128. Carriers for containers. Ralph J. Failor. Filed Sept. 17, 1948. 14 claims. (Cl. 294-87.2.) Carrier for bottles and cans with openings through which the top of the container is forced, whereupon the bead or crown of the container is engaged by a deformed flap in the opening.

2,650,163. Butadiene-styrene sized paper and method. Eleanor F. Horsey and William D. Thompson, assignors to Hercules Powder Co. Filed May 21, 1947. 11 claims. (Cl. 92-3.) Wet strength and resistance to penetration of water-base inks are greatly improved by addition to the beater of a butadiene-styrene copolymer latex.

2,650,261. Gas-filled electric cable with paper and polystyrene insulation. Edward L. Davey, assignor to W. T. Glover & Co. Ltd. Filed Sept. 27, 1950. 2 claims. (Cl. 174-25.)

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2,650,459. Wrapping machine. James J. McGinley, assignor to American Machine and Foundry Co. Filed May 17, 1947. 12 claims. (Cl. 53-110.) Machine for automatically wrapping and sealing articles such as sliced or unsliced loaves of bread.

2,650,565. Coating machine and electrode panel therefor. Laurence W. Spooner, assignor to General Electric Co. Filed Dec. 30, 1949. 3 claims. (Cl. 118-51.) Device for depositing fibers or abrasive particles by electrostatic force on an adhesively coated base sheet employs electrodes completely enclosed in an insulating material to inhibit corona formation.

2,650,643. Sealing mechanism for wrapping machines. Alfred R. Fuches. Filed April 3, 1948. 24 claims. (Cl. 154-42.) Heated and cooled rollers successively engage the areas to be sealed on articles (e.g., loaves of bread) wrapped with waxed paper.

2,650,705. Method and apparatus for handling paper. Herbert T. Randall, assignor to The Champion Paper and Fibre Co. Filed Aug. 5, 1946. 14 claims. (Cl. 209-123.) Sorting station platform mounted above a conveyor is composed of small, closely spaced rollers to facilitate moving the stack onto the conveyor.

2,650,751. Carton. Edwin Carl Goers, assignor to Marathon Corp. Filed June 5, 1951. 1 claim. (Cl. 229-31.) Folding carton may be erected without adhesive and contains a locking flap which engages the hinged cover.

2,650,825. Paper jogger. Harold E. Cooper. Filed April 20, 1950. 1 claim. (Cl. 271-89.) Small paper jogger energized by an electromagnet.

September 8, 1953

R23,712. Combination shirt board and collar protector. Joseph A. O'Reilly. Application for reissue Oct. 3, 1952. 15 claims. (Cl. 223-71.)

2,651,076. Thermoplastic film-forming machine. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed Aug. 17, 1949. 13 claims. (Cl. 18-9.) Shearing roll is opposed by an arcuate shaped shoe which controls thickness of coating or film by the pressure applied to the shoe.

2,651,077. Machine for coating with thermoplastic materials. Edgar J. Justus, assignor to Beloit Iron Works. Filed Dec. 30, 1950. 6 claims. (Cl. 18-9.) Thermoplastic coating is applied to paper at the nip formed by the doctor roll and shearing roll; the pressure at the nip controlled by a diaphragm system with pressure applied along the roll in a manner that does not interfere with rotation.

2,651,131. Package wrapper. Gretchen G. Long and Vers Y. Long. Filed Feb. 18, 1950. 6 claims. (Cl. 41-34.) Fancy wrapping paper.

2,651,153. Assembling and gluing for interlocking containers. Edward N. Burnett, assignor to Gerber Products Co. Filed Oct. 3, 1950. 18 claims. (Cl. 53-3.) Containers are glued together in pairs by means of projecting flaps formed as a part of the container.

2,651,241. Antideflection roll, method of assembly, and use. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed May 17, 1949. 11 claims. (Cl. 92-73.) A calender roll contains a central shaft on which the external shell is supported by concentric rings and a rubber insert sleeve. The load is carried by the central shaft and the shell retains a true cylindrical shape.

2,651,242. Calender roll guide and feed mechanism. Walter W. Neely, assignor of one half to Herbert W. McAfoos. Filed Sept. 24, 1947. 4 claims. (Cl. 92-74.) Guide rollers mounted on alternate sides of the rolls in a calender stack are brought into contact with the associated roll to automatically thread the web through the stack.

2,651,283. Conveyor and adhesive applicator for carton blanks. Julius A. Zinn, Jr. Filed June 30, 1949. 3 claims. (Cl. 118-2.) Conveyor system for handling irregular-shaped carton blanks employs blank engaging lugs to carry the blanks past the adhesive applying rolls.

2,651,284. Wax coating apparatus. Julius A. Zinn, Jr., Odd Wennberg, and Jack Swendsen. (Wennberg and Swendsen's interest assigned to Zinn.) Filed June 1, 1950. 10 claims. (Cl. 118-6.) Formed cartons are immersed in a wax bath, then drained as they pass through a heated chamber.

2,651,287. Electrostatic coating apparatus. Robert H. Turner, assignor to Ransburg Electro-coating Corp. Filed March 10, 1949. 7 claims. (Cl. 118-51.) Electrostatic atomizing and deposition of coating material on a sheet is accomplished by an elongated discharge head with plates at either end to control dispersion from the end of the head.

2,651,364. Method of and apparatus for cutting paper and like webs. Arthur Ashman, assignor to Colodense Ltd. Filed June 24, 1950. 7 claims. (Cl. 164-17.) Apparatus for severing bag tubing into bag lengths by means of knives mounted above and below the forming plate.

2,651,409. Tissue dispenser. Joseph W. Fay, assignor of one half to Irwin J. Mendels. Filed April 29, 1952. 5 claims. (Cl. 206-57.) Disposable cardboard carton with tear lines for packaging tissues in a dispensing box.

2,651,447. Storage bin. Charles R. Seaborne, assignor t

Chilmany Pulp & Paper Co. Filed July 7, 1949. 2 claims. (Cl. 229-4.5.) Storage bin for farm crops, bulk chemicals, etc., with multi-ply paper wall having metal banding reinforcement contained within the wall.

2,651,448. Filler for cartons. John L. Dusseault, assignor to Patent Protection Corp. Filed Aug. 19, 1950. 2 claims. (Cl. 229-14.) Triangular corrugated board fillers are employed to position a boat or similar object within a container formed from corrugated board.

2,651,449. Container construction. Edward N. Burnett, assignor to Gerber Products Co. Filed Jan. 28, 1950. 12 claims. (Cl. 229-23.) Container construction for interlocking two units for shipment which may be readily separated to individual units.

2,651,450. Sealed container. Ransome C. Ellsworth, assignor to The Ohio Boxboard Co. Filed May 8, 1950. 1 claim. (Cl. 229-44.) Paperboard container with a reclosable cover and glued seals to prevent pilfering.

2,651,451. Valve bag. Richard F. Bennett, assignor to Universal Paper Bag Co. Filed April 18, 1950. 1 claim. (Cl. 229-62.5.) Fringe elements on the inner edge of the valve provides a seal in the valve bag claimed.

2,651,571. Alkaline treating method for obtaining ramie and other fibers. John C. van Dyk, assignor to Howard E. St. John and Laura P. St. John. Filed June 26, 1948. 7 claims. (Cl. 8-10.) Cooking liquor for undecorticated ramie, jute, hemp, sisal, pita, and linen or seed flax contains an alkali metal silicate, ethyl ethanolamine, and oleic acid.

2,651,580. Mineral coated paper and coating composition therefor. Arthur Reilly, assignor to S. D. Warren Co. Filed Sept. 1, 1949. 12 claims. (Cl. 106-144.) Ammonium resinate added to mineral coating composition imparts sufficient water repellence to the surface to reduce the quantity of lithographic fluid required.

2,651,581. Method of making a cuprammonium cellulose solution. Edward J. Cortney, assignor to Cellulose Fibers, Inc. Filed July 30, 1952. 4 claims. (Cl. 106-167.) Similar to U. S. Patent 2,651,582 (Sept. 8, 1953).

2,651,582. Method of making a cuprammonium cellulose solution. Edward J. Courtney, assignor to Cellulose Fibers, Inc. Filed Dec. 22, 1952. 10 claims. (Cl. 106-167.) Method and machine for making fiber-free cuprammonium cellulose solution.

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2,651,873. Molded decoy. Arthur H. Risch and Arthur J. Nelson, assignors to Pulp Reproduction Co. Filed Dec. 14, 1950. 3 claims. (Cl. 43-3.) Molded pulp decoy with detachable head allows forming a seamless body.

2,651,897. Container forming and filling machine. Stanley Howard assignor to Pneumatic Scale Corp., Ltd. Filed June 7, 1947. 1 claim. (Cl. 53-89.) Heat-sealable paper web is formed into bags and filled with a measured quantity of a product such as tea.

2,651,898. Apparatus from packing and sealing shipping cases. Wallace D. Kimball, assignor to Emhart Manufacturing Co. Filed Nov. 14, 1947. 3 claims. (Cl. 53-91.) Container blanks are erected, adhesive applied, the container filled, and the top flaps sealed in this apparatus.

2,651,899. Book and wrapper feed mechanism for wrapping machines. Raymond E. Ackley, assignor to W. F. Hall Printing Co. Filed April 20, 1950. 3 claims. (Cl. 53-98.) Band wrapper and its associated book magazine, etc., are fed simultaneously to the bite between conveyor belts of this machine.

2,651,900. Wrapping machine. Bernard Heilman, assignor to L. A. Young Spring & Wire Corp. Filed July 5, 1951. 15 claims. (Cl. 53-98.) Rodlike articles are bound together by this wrapping machine that employs adhesive tape and a rotary wrapping head at each wrapping point.

2,651,976. Grinding disk. Daniel Sutherland, assignor to Ethel M. Sutherland and Douglas G. Sutherland. Filed Nov. 21, 1952. 14 claims. (Cl. 92-26.) Grinding disk wherein the passage of pulp between the faces is controlled by check rings in the disk face.

2,652,059. Index card and removable index tab. Frank Lloyd Wassell, assignor to Georgene Parkin Wassell. Filed Nov. 15, 1950. 6 claims. (Cl. 129-16.8.) Perforations along one side of the index card provides for attachment of tabs for special indexing of the card.

2,652,077. Feeding mechanism for chippers. Ronald R. Alexander, assignor to Carthage Machine Co. Filed Nov. 22, 1950. 3 claims. (Cl. 144-176.) Thin, irregular material such as sawmill waste is confined between a conveyor and rollers and fed into the chipper at a constant rate.

2,652,157. Overhead log carrier. Jakob Wyssen. Filed July 14, 1947. 6 claims. (Cl. 212-98.) Overhead log carrier employs control elements to prevent movement of the carrier while the load is hoisted.

2,652,185. Corner locking construction for paperboard containers. Ralph E. Acker, assignor to Container Corp. of America. Filed Jan. 6, 1950. 10 claims. (Cl. 229-35.) Corner locking construction for tray-type paperboard container.

2,652,186. Carton. Julius A. Zinn, Jr. Filed March 8, 1947. 6 claims. (Cl. 229-38.) Closure flaps seal carton to prevent loss of finely divided materials or liquids.

2,652,187. Paper bag handle. Harford K. Steen and Harold L. Thompson, assignors to Interstate Bag Co., Inc. Filed July 8, 1950. 8 claims. (Cl. 229-54.)

2,652,247. Feed mechanism for carton blank forming apparatus. Gideon Kane. Filed May 29, 1950. 4 claims. (Cl. 271-2.4.) A web of paper or boxboard is printed and perforated along one edge, then fed into this mechanism where a feed belt engages the perforations to ensure registration with the blank-forming apparatus.

2,652,325. Asbestos dispersions. Izador J. Novak, assignor to Raybestos-Manhattan, Inc. Filed April 1, 1952. 7 claims. (Cl. 92-1.) Chrysolite asbestos fibers dispersed with a water-soluble fatty acid soap exhibit improved performance on the paper machine when the pH is raised by addition of an alkali such as potassium hydroxide.

2,652,351. Paper adhesive tape. James S. Gerhardt, assignor to Eastman Kodak Co. Filed Sept. 2, 1949. 3 claims. (Cl. 154-53.5.) Pressure sensitive tape is formed with a laminated paper backing and two or more layers of pressure sensitive adhesive applied to one side and an impermeable material applied to the other side to prevent adhesion of the tape in the roll.

2,652,374. Water resistant paper coatings and method of making same from urea-formaldehyde, ammonium metaphosphate, amylaceous material, and clay. Ralph N. Thompson, assignor to Calgon, Inc. Filed Jan. 31, 1951. 7 claims. (Cl. 260-17.3.) Water resistant coating for paper or paperboard contains clay, melamine or urea-formaldehyde resin, starch, about 0.20% ammonium metaphosphate, and has a low initial viscosity that does not increase upon aging.

2,652,375. Production of articles of improved water resistance from urea-formaldehyde resins. David E. Cordier and William D. Williams, assignors to Libbey-Owens-Ford Glass Co. Filed March 8, 1951. 4 claims. (Cl. 260-17.3.) Molding composition with improved water and shrink resistance is made by impregnation of alpha-cellulose with melamine-formaldehyde, drying, then impregnating with urea-formaldehyde and drying and grinding to powder form.

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2,652,670. Wrapping and sealing machine for tampons. John A. Carrier, assignor to Sanitary Products Corp. Filed Nov. 20, 1950. 3 claims. (Cl. 53-134.) Tampons are wrapped in a thermoplastic material such as cellophane and sealed by suitable heating elements while the items are carried in a conveyor unit.

2,652,834. Cigarette paper. Milton O. Schur and Robert M. Levy, assignors to Ecusta Paper Corp. Filed March 7, 1952. 8 claims. (Cl. 131-15.) Cigarette paper treated with diammonium phosphate, guanidine carbonate, and tetrasodium phosphate burns to a grayish-white, cohesive ash.

2,652,835. Cigarette paper. Milton O. Schur and Robert M. Levy, assignors to Ecusta Paper Corp. Filed March 7, 1952. 4 claims. (Cl. 131-15.) Cigarette paper treated with approximately 0.75% of guanylurea phosphate burns with a grayish-white ash that adheres to the tobacco ash.

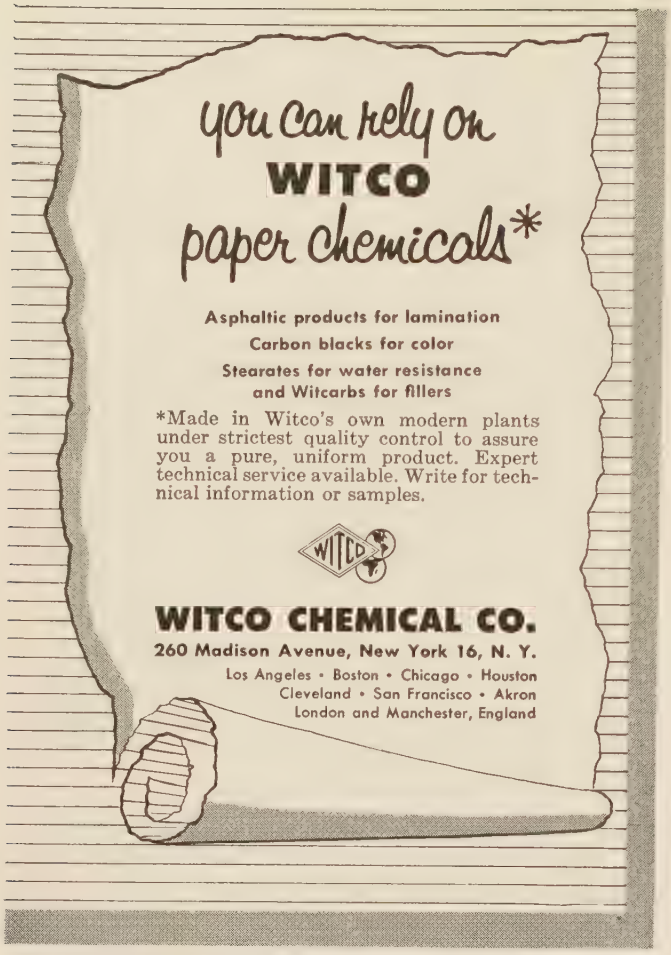
2,652,867. Portable log debarker for sawmills. John R. Boswell, assignor to The Bark-Off Corp. Filed Oct. 10, 1949. 17 claims. (Cl. 144-208.) Bark is abraded from crooked and irregular logs by spur wheels, chains flails, and smooth tired wheels in this device which may be disassembled to facilitate movement to a new location.

2,652,868. Bark-removing tool having oppositely rotating toothed rollers. Reginald H. Grant. Filed Oct. 10, 1952. 3 claims. (Cl. 144-208.) Oppositely rotating rollers in the head of this bark-removing tool force the head between the log and bark of redwood.

2,652,878. Method of making shock absorbing and insulation material. George A. Gerard, assignor to Cottonwood Products, Inc. Filed Nov. 30, 1951. 1 claim. (Cl. 154-28.) Laminated sheet useful for shock absorbent wrapping or insulating material is made by spraying a macerated printed paper with a printing ink solvent, then incorporating the material between cover sheets of kraft paper and embossing the sheet.

2,652,921. Flatware package. Thomas W. Foster, assignor to Container Corp. of America. Filed May 21, 1951. 4 claims. (Cl. 206-45.19.) Paperboard tray contains an insert for holding flatware in nested relation in a series of slots with slits for holding the blade of a knife or similar article.

2,652,922. Container for packaging toruslike objects and articles. Edward F. Schweich, assignor to Lewin-Mathes. Filed March 8, 1950. 6 claims. (Cl. 206-59.) Corner flaps from the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square bottom section are folded over the octagonal top section to form a package for pancakelike objects.

2,652,968. Bottle carrier. Hubert Velman Bolding, assignor to The Bradley & Gilbert Co. Filed July 2, 1948. 4 claims. (Cl. 229-28.)

2,652,969. Carton. Harold A. Pfaff, assignor to Marathon Corp. Filed Dec. 3, 1951. 7 claims. (Cl. 229-33.) Folding carton comprises a tray with hinged cover engaged by a locking flap on the front wall of the tray portion.

2,652,970. Folded-blank carton. Walter C. George, assignor to Gaylord Container Corp. Filed Oct. 1, 1948. 2 claims. (Cl. 229-37.) Carton formed from one-piece folded blank.

2,652,971. Disposable drinking cup. Jack K. McFarland and Wilmer C. Neiss. Filed July 3, 1950. 1 claim. (Cl. 229-52.) Paper cup lined with metal foil.

2,652,972. Paper bag. Harold C. Davis, assignor to Bemis Bro. Bag Co. Filed Oct. 13, 1949. 2 claims. (Cl. 229-55.) Paper bag with cardboard bottom and reinforcing paperboard corner strips for storage of empty cans in warehouse stacks.

2,653,079. Process for the preparation of chlorine dioxide. Ernst Wagner, assignor to Deutsch Gold- und Silber-Scheidenstalt vormals Roessler. Filed June 6, 1949. 3 claims. (Cl. 23-152.) A dry gas is passed through an acidified chlorate reaction solution in such quantity that the entrained water vapor controls the exothermic reaction at a temperature of 75 to 90 °C.

2,653,110. Manifolding transfer and method of making. Jerome G. Zimmerman, assignor to The Standard Register Co. Filed March 17, 1948. 15 claims. (Cl. 117-36.) Transfer coating that is white, solid, and nonsticky is developed on the receiving sheet by exposure to anhydrous ammonia to a semi-black, clear, nonsmudging image.

2,653,126. Method of marking. Harold G. Greig, assignor to Radio Corp. of America. Filed Feb. 23, 1950. 6 claims. (Cl. 204-2.) Facsimile or telautograph paper sensitive to an electrical current is produced by impregnation with a solution of sodium nitrite and sodium sulphamate.

September 29, 1953

2,653,429. Method and means for packaging. Francis Henry Fitzgerald. Filed Sept. 24, 1951. 4 claims. (Cl. 53-9.) Packaging method for finely ground material such as taconite ore involves filling a trough of paper, winding into a spiral, and adhesively securing the edges of the trough to the previously wound material.

2,653,431. Bag baling machine. Paul C. Robinson, assignor to Arkell and Smiths. Filed Sept. 28, 1950. 6 claims. (Cl. 53-57.) Paper bags are stacked on the wrapping paper then compressed and the wrapper sealed to form a bale.

2,653,435. Wrapper tucking mechanism. Robert E. Taggart, assignor to Lynch Corp. Filed Sept. 8, 1951. 6 claims. (Cl. 53-151.) Tucking element to fold in the end flaps in a package-wrapping machine.

2,653,520. Pulp treating apparatus. Karl Arvid Karlsson. Filed April 22, 1948. 5 claims. (Cl. 92-26.) Tank with impeller mounted near the bottom to defiber dry lap, wastepaper, etc.

2,653,521. Apparatus for wet-treating fibrous matters. Sten E. Ahlfors. Filed Nov. 4, 1946. 7 claims. (Cl. 92-36.) Apparatus for screening, washing, or dewatering pulp comprises a vibrating, perforated drum mounted for rotation within a vibrating vat.

2,653,522. Paper machine. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed Sept. 10, 1947. 11 claims. (Cl. 92-49.) Press rolls are arranged so that the nips lie in a horizontal plane to facilitate threading the tail of the web through the press section.

2,653,523. Reverse section press assembly. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed Sept. 27, 1950. 2 claims. (Cl. 92-49.) The web traveling through the press section is always supported by one of several felts while suction is applied successively through opposite faces of the web.

2,653,524. Carton erecting mechanism. Robert J. Hickin, assignor to The Ohio Boxboard Co.. Filed May 2, 1951. 10 claims. (Cl. 93-51.) Erecting mechanism for hook-end cartons.

2,653,566. Web coating machine. Elmer J. Worden. Filed Jan. 18, 1951. 2 claims. (Cl. 118-63.) An air jet, located at the back side of the coating nip, is directed at the edge of the web to wipe the coating from the web and prevent accumulation of coating on the rolls.

2,653,635. Bark removing machine. Donald Denison, assignor to Bates & Chard Co. Filed Oct. 1, 1951. 2 claims. (Cl. 144-208.) Bark is removed from slab wood by swinging hammers flexibly attached to a rotating shaft. Length of the hammers is adjusted to approximate the curvature of the slab.

2,653,708. Carton and packing cell. Richard O. Spalding, assignor to Owens-Illinois Glass Co. Filed April 26, 1949. 3 claims. (Cl. 206-46.) Folded insert is employed to space a bottle within a carton and prevent contact with the sides.

2,653,710. Packaging window shades. Charles M. Judd, assignor to The Chas. W. Breneman Co. Filed Sept. 8, 1950. 1 claim. (Cl. 206-59.) Core for winding replacement shades consists of a paper or cardboard tube.

2,653,727. Taping machine. Adolph A. Wagner, Arnold J. Werner, and William R. Ross. Filed April 8, 1950. 2 claims. (Cl. 216-22.) Machine applies tape to top flaps of cartons on conveyor, severs tape between cartons, and rolls down ends of tape.

2,653,740. Slip-resistant pants guard for coat hangers. William F. Tufts, assignor to L. M. Leathers Sons. Filed Feb. 28, 1952. 1 claim. (Cl. 223-98.) Slip-resistant material is applied to the paperboard strip on a wire coat hanger.

2,653,742. Bottle carrier. Grover C. Currie, assignor to Dacam Corp. Filed June 7, 1951. 8 claims. (Cl. 224-45.)

2,653,743. Machine for placing dishes in cartons or containers. Richard C. Stenger, assignor to Sutherland Paper Co. Filed Jan. 10, 1949. 2 claims. (Cl. 226-2.) Suction cup device removes a single paper plate from the bottom of a stack and drops same into a chute for delivery to a waiting carton.

2,653,749. Bottle carrying carton. Jack Milchin. Filed Jan. 26, 1949. 1 claim. (Cl. 229-28.)

2,653,740. Carrier for bottles and the like. Oscar L. Vines. Filed Feb. 26, 1949. 6 claims. (Cl. 229-28.)

2,653,830. Manifolding. Douglas A. Newman, assignor to Columbia Ribbon and Carbon Manufacturing Co., Inc. Filed Aug. 10, 1948. 14 claims. (Cl. 282-19.) Perforations in bands of adhesive applied to a web make rolling the web possible without wrinkling or tearing.

2,653,854. Corrosion inhibiting packaging material and method of packing. Charles H. Schaar, assignor to The Cromwell Paper Co. Filed Oct. 17, 1949. 7 claims. (Cl. 21-2.5.) Vapor phase rust inhibitor for adding to wax coating composition is made by reacting dichlorohexylamine and caprylic acid at room temperature.

2,653,870. High-strength paper and method of making. Richard P. Kast. Filed Oct. 22, 1949. 2 claims. (Cl. 92-3.) A strong paper is made by the addition of 15% long fibers (e.g., manila, sisal, cotton, nylon) to a wood pulp sheet together with a latex emulsion added as a beater size and a surface sizing agent.

2,653,888. Method of forming container blanks. Mark Hyman, Jr., assignor to Polaroid Corp. Filed Feb. 24, 1949. 1 claim. (Cl. 154-116.) Method of applying a band of ethyl cellulose adhesive to a web, then slitting the web in the center of the band to form two webs, each having a band of adhesive on one edge.

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Fifth Coating Conference, Poland Spring House, Poland Spring, Me., May 24–26, 1954.

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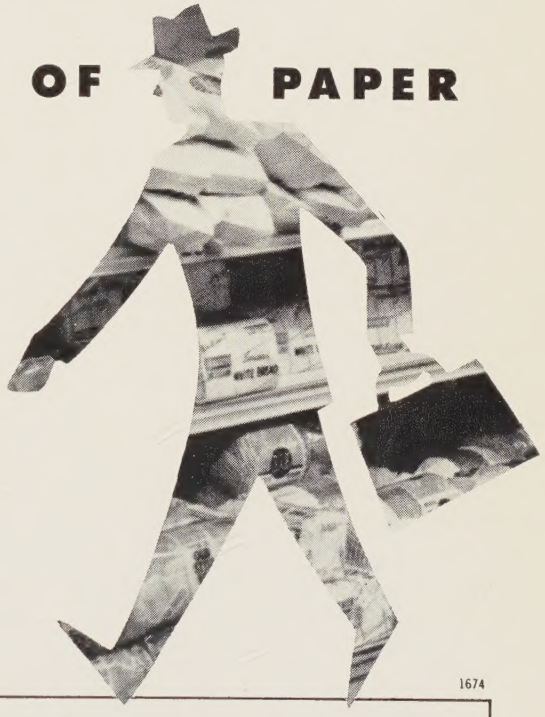

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